The
Chemical Age

Established 1919

The Weekly Journal of Chemical Engineering and Industrial Chemistry

BOUVERIE HOUSE 154 FLEET STREET LONDON E.C.4
Telegrams: ALLANGAS FLEET LONDON · *Telephone:* CENTRAL 3212 (26 lines)

Volume LXIV 19 May 1951 Number 1662

Prevention of Pollution

ALL those concerns which discharge their trade effluent into rivers will be affected by a Bill which is at present before Parliament and is likely to become law in the near future. At present, concerns discharging effluent into rivers must comply with the Rivers Pollution Prevention Act, 1876, and may also be faced with an action for nuisance by owners of land nearer the mouth of the river if they interfere with the natural quality of the river water. The 1876 Act provides that it shall be an offence to discharge poisonous, noxious, or polluting liquid from a factory into a river or stream, and enforcement of this Act is now in the hands of river boards. Before, however, they can bring proceedings, they must obtain the Minister's approval, and he, in making his decision, must have regard to 'industrial interests involved in the case and to the circumstances and requirements of the locality.' Further, before consenting to the bringing of proceedings, the Minister must satisfy himself that reasonably practicable measures are available so that the factory concerned will be able to remain in production if an order to cease the pollution is made.

It is therefore a matter of some difficulty for a river board to exercise its powers under the 1876 Act, and the Rivers (Prevention of Pollution) Bill which is now before Parliament, largely follows the lines recommended in the Hobday Report. In it, an effort has been made to determine whether the particular effluent which is produced by their processes may be discharged into a river without treatment. The Bill will place upon river boards the responsibility of surveying rivers within their area, and, where necessary, of drawing up bye-laws for the rivers as a whole, or for individual stretches of them. These bye-laws will lay down standards from which it will be possible to determine whether or not the discharge of a particular effluent constitutes an offence. As regards these bye-laws, it should be noted particularly that the Bill expressly provides that effluent may be polluting solely by reason of its colour or temperature. It will therefore be feasible for a bye-law to provide that a discharge of heated water, used in a cooling system, will constitute pollution if it exceeds a specified temperature.

It will take some time for river boards to carry out their surveys and recordings, and it is unlikely that any bye-laws made under the powers contained in the Bill will come into force for three or four years. Individual river boards will have the task of preparing their own draft bye-laws, but these drafts will be subject to the Minister's confirmation. During

the debates he has stated that if there are any objections to a draft bye-law, a public local inquiry will be held by one of his officials. Under a further Ministerial concession made during the Committee Stage of the Bill, river boards will be obliged to consult 'any body of persons designated to them for this purpose by the Minister', before putting draft bye-laws forward for the Minister's approval. This is a valuable provision as industry is not entitled under the River Boards Act, 1948, to any direct representation upon river boards, a majority of the members of which are local authority nominees.

After the Bill has come into force, but before bye-laws are made, and for all those stretches of rivers and streams for which bye-laws are not made, general provisions set out in the Bill will apply. These provisions make it an offence to cause or knowingly permit any poisonous, noxious or polluting matter to enter a stream, but before prosecution for this offence, river boards must obtain the Minister's approval.

It had been the Government's intention to take from riparian owners their right to obtain an injunction and damages against persons interfering with the natural quality of the water which flowed past their property. This would have meant that where bye-laws under the Bill were in force, the industrialist's sole duty would have been to ensure that the trade effluent from his plant complied with the standard laid down. He would not have been liable to proceedings by lower riparian owners on the grounds that he had infringed their right to receive the water in the river flowing past their land in its natural condition. As a result of pressure from Members representing all parties, this proposal was withdrawn; industrialists will therefore themselves have the protection of the law of nuisance against owners of property higher up the rivers adjoining their lands. They will, however, be liable to have an injunction granted against them at the suit of lower riparian owners, even though their effluent complies with the appropriate river board bye-laws.

The existence of bye-law standards for effluents will generally be considered to be a step in the right direction provided the standards are not unreasonable. Industrialists should therefore take care to keep themselves informed of developments in districts in which they are interested. In particular, where a new discharge into a river is commenced, notice to the local river board must be given; clearly, when there is an intention to make such a discharge or to increase an existing discharge, contact should be made with the river board as soon as possible. Their advice as to the content of the effluent can then be obtained before any expense on capital works is incurred.

On Other Pages

The annual subscription to THE CHEMICAL AGE is 35s. Single copies, 9d.; post paid, 1s.; SCOTTISH OFFICE: 116 Hope Street, Glasgow (Central 3970). MIDLANDS OFFICE: Daimler House, Paradise Street, Birmingham (Midland 0784-5). THE CHEMICAL AGE offices are closed on Saturdays in accordance with the adoption of the five-day week by Benn Brothers, Limited.

Notes & Comments

The SCI Report

RECENTLY *Chemistry and Industry* (12 May, 1951) devoted its principal leader to an apology for the Society's inability to publish the 1950 Annual Reports by the date originally planned, round about mid-1951. The Society of Chemical Industry has in fact no reason for apologising at all, for the delays associated with these Annual Reports have been outside its control. The 1949 Reports did not appear until early in 1951—in that case the printing crisis of the autumn before caused the delay. For the Reports in hand, the Society has been unable to obtain paper and 'so far that difficulty has not been surmounted.' Yet great efforts had been made by contributors and the editorial staff of the Society to secure earlier publication for the 1950 Reports. Now all that effort has been 'completely frustrated.' It is an ironic aspect of the situation that one section of these Reports is itself entirely devoted to progress in the science and technology of 'Pulp and Paper'!

Situation Fantastic

THIS situation is surely fantastic. A large number of experts in their own branches of applied chemistry have been gathered together, have studied a year's published progress in these subjects, and have given much of their leisure hours to produce reports. These reports have been edited and by the spring of 1951 the complete set of MSS was in the hands of the printers, and much of the material already passed in proof form. Let it be remembered that the 1949 Reports ran to more than 800 pages of text alone and the vast size of this project can be realised. And there it must wait, bottle-necked for paper on which to print it. This is not the time or place to discuss the general or international problem of paper shortage. It is, however, appropriate to ask whether a country can lay claim to any leadership in industrial science if the small quantity of paper required for its principal annual reports on technological progress cannot be given some priority of supply. Moreover, this single example of paper trouble may be the dreary harbinger of bigger troubles to come for the publications of our scientific societies and organisations. It may well prove a fact later this year that the vast amount of paper taken for Festival publications prevents British science maintaining its normal rate and volume of publication.

Materials and Ministries

FRESH attention has recently been focused on problems of shortages by the departure for America of Mr. R. R. Stokes, Lord Privy Seal, and by questions in the House of Commons about the new department for handling raw materials. Creation of a Ministry of Materials should help to clarify the position. For too long there has been no definite plan, partly perhaps because there has been no single department responsible for raw materials which have been split between the Board of Trade and Ministry of Supply, each of which has been overburdened with other problems. International discussions on this vital matter are becoming increasingly complex and to have a single authority in London should be a real advantage. The new Ministry's inauguration has come at a hopeful time. The American decision on sulphur allocation to Britain is an example of practical good will, while recent statements of U.S. policy by Mr. Acheson and Mr. Charles Wilson were encouraging. There is also a slight indication that the position may be easier. Re-stocking both by governments and to a larger extent by private industry is shown to be slackening. This may be because stocks have largely been replenished or because of high prices. If this continues, demand may not so far exceed supply as to make possible an agreed international allocation. One wise decision is that while the new Minister is responsible for the procurement of materials he is not responsible for their distribution. There is, indeed, much to be said for those who allocate being totally separate from those who secure.

American Crop Protection

Progress in Use of Chemicals

EXTENSIVE use of chemicals in crop production can go a long way towards helping to offset the shortage of farm labour and increasing crop yields during the emergency, according to Dr. Robert M. Salter, chief of the bureau of Plant Industry, Soils, and Agricultural Engineering of the U.S. Department of Agriculture. Speaking at the 18th semi-annual meeting of the National Agricultural Chemicals Association at Miami, Florida, he said that research has developed a tremendously wide range of new uses on farms for chemical materials.

Chemicals have become a much more potent instrument for increasing production and saving labour now than they were during the last war, Dr. Salter explained. Many modern uses have been perfected since then, and others appear highly promising in current research projects. As recently as 1945 the use of chemicals for weed control in agriculture was greatly restricted. Last year farmers applied weedkiller to more than 30 million acres of cropland in the U.S.A.

New Applications

Dr. Salter reported new advances in the use of chemicals for controlling weeds, fungus diseases, soil pests, and for retaining and improving the quality of crops. Equally spectacular progress has been made with insect control and in the application of chemical fertilisers, he continued. While 2, 4-D is the most widely used weedkiller in America, the doctor reported practical uses in weed control for many other chemicals such as 2,4,5-T, IPC, TCA, ammonium sulphamate, cyanamide, chlorates, arsenicals, boron compounds, dinitro compounds, herbicidal oils, and others.

The current trend in weed control research is to concentrate study on specific crops and under specific problem conditions. Studies were reported under way on almost every crop grown in America. Dr. Salter said that one of the most significant developments is centred round the use of chemicals as sprays that kill weed seedlings during the process of germination. Promising results from pre-emergence treatments were reported with sugar beet, cotton, peanuts, soya beans, potatoes, maize, and under certain conditions, asparagus, gladioli, and other field and horticultural crops. The use of TCA as a pre-emergence weed control measure in Mid-Western sugar beet fields is expected to eliminate the need for many labourers for hand weeding this year.

The discovery that complex organic materials such as dithiocarbamates, phenyl mercury compounds, dichloro, naphthaquinone, glyoxalidines, dinitro compounds, and phthalimide derivatives are effective fungicides was cited as the most important advance with chemicals for controlling fungus on plants. These materials represent the results of a decade of close teamwork between the chemical industry and plant pathologists. Their use reduces the demand for strategic materials such as copper and sulphur. Organic compounds have solved most of the problems of fruit and vegetable damage from copper fungicides, Dr. Salter explained, and promise a solution to fruit damage from sulphur under many conditions.

In 1950 about 20,000 acres of apple orchards in the Pacific North West area were thinned with spray applications of dinitro at blossom time. Experimental studies show that chemical thinning gives a 15 per cent increase in yield for only a fraction of the cost of hand thinning.

World Petroleum Congress

SOME 1,500 delegates from over 20 countries, including Great Britain, will attend the third World Petroleum Congress to be held at The Hague from 28 May to 6 June, under the patronage of Prince Bernhard of the Netherlands and the presidency of Jonkheer O. C. A. Van Lidth de Jeude, president of the Royal Netherlands Institution of Engineers.

The first congress was held in London in 1933 and the second four years later in Paris. The success of the original congress, at which all the many specialised sciences and techniques embodied in the oil industry were discussed, led to the decision to hold such conventions periodically.

Production of chemicals from petroleum, their properties and applications, is among the wide range of subjects to be discussed at the forthcoming meeting. Other matters to be considered will include utilisation of oil products, construction of petroleum equipment, and anti-corrosion precautions.

Research in Analytical Chemistry

School at Birmingham Solves Industrial Problems

JUST over a year ago the first Research School of Analytical Chemistry was set up at Birmingham University under the direction of Mr. R. Belcher, F.R.I.C., F.Inst.F., Senior Lecturer in Analytical Chemistry at the University. Many such schools are in existence on the continent which in recent years have made many valuable contributions to the subject. The work of the Birmingham School may be divided into two main categories: (1) Research into industrial analytical problems, (2) Fundamental, *i.e.*, academic research. Both categories are, however, more closely linked than is suggested by such a division. For example, the results of academic research work—which work must necessarily be neglected by industry because of the time involved—may often be of the utmost value to industry.

The rapid determination of sodium and potassium in a wide variety of materials is one of the major problems in industry. For example, coal ash contains sodium and potassium in varying amounts, and the accurate determination of these elements is of importance to industrial coal and coke consumers. At the present time, the classical method of determination is employed (described in British Standard No. 1016). Potassium is determined as the perchlorate or chloroplatinate after separation of the mixed chlorides, and sodium estimated by difference, or the sodium may be determined as the triple salt and the potassium estimated by difference. Both methods, however, are time-consuming and take 3-4 days to complete.

Modified Method

In a modified method, the coal ash is opened-out by the conventional Lawrence Smith procedure, the leachings made up to a known volume, and sodium and potassium determined separately on suitable aliquots taken from this solution. The potassium is determined by the cobaltinitrite procedure. Under the conditions employed an empirical factor has to be applied to give the true potassium content. The sodium is determined gravimetrically as sodium zinc uranyl acetate, or the precipitate of triple salt may be determined alkalimetrically using a mixed bromothymol blue—phenolphthalein indicator. A potentiometric procedure is preferred when amounts of sodium up to 20 mg. are present in the aliquot. By this procedure the analysis of the alkali content of coal ash, refractories and silicate minerals may be carried out in less than half a working day (ca. 4 hours).

Studying Precipitate Variations

When potassium is precipitated with cobaltinitrite, the precipitate obtained is of variable composition. Under special conditions of precipitation, a precipitate of constant composition is obtained, which may be related to the amount of potassium present by the use of an empirical factor. At the present time, a study is being made of potassium cobaltinitrite precipitates formed under different conditions using X-ray and electron microscope methods. In this way it is hoped to shed some light on the variation in composition of the precipitate.

A method has also been developed for the determination of potassium. The potassium is precipitated as the 12-phosphomolybdate and the precipitate determined alkalimetrically. Satisfactory results have been obtained on as little as 0.1 mg. of potassium.

The determination of zinc is again of special importance to industry. Rapid methods based on the titration of the zinc with ferro-cyanide have been used, but the indicators hitherto proposed for this titration have not proved entirely satisfactory. The problem has been solved by the development of two new indicators, naphthidine and 3,3′-dimethylnaphthidine both of which are superior to any of the conventional indicators for the zinc-ferrocyanide titration. Of the two 3,3′-dimethylnaphthidine is preferred, as it gives a slightly better colour change than naphthidine and is ten times more sensitive, giving a sharp end-point change when 0.001M zinc solutions are titrated. The two indicators have been satisfactorily applied to the determination of zinc in many industrial materials, *e.g.*, rubber, paint, and alloy steels. 3,3′-dimethylnaphthidine provides a sensitive test for oxidising agents and, in particular, for vanadate. Consequently, a very sensitive method has been developed for the

micro-determination of vanadium in steel. At the present time, the sulphonic acid derivatives of naphthidine and 3,3′-dimethylnaphthidine are being examined. Preliminary tests have shown that they can be used in titrations with ceric sulphate and dichromate and that they give instantaneous end-points in the zinc-ferrocyanide titration.

Properties of Benzidine

The naphthidine derivatives were developed as a result of a fundamental study of some substituted benzidines and related compounds. Benzidine, as is well known, has been widely used as a reagent in analytical chemistry. It possesses three particular properties which make it such a valuable reagent: (1) it is easily oxidised to an intensely blue-coloured product, (2) it forms complexes with metallic salts, (3) it forms salts with acids. It seemed probable that an examination of the reactions of certain substituted benzidines and related compounds would yield new reagents with properties superior to those of benzidine.

Thus, benzidine has been used for the determination of sulphate in many industrial materials. The method is rapid, as the precipitate of benzidine sulphate obtained may be determined titrimetrically. Benzidine sulphate, however, is not entirely insoluble and considerable washing losses are incurred. A compound possessing a less soluble sulphate than benzidine would be more acceptable as an analytical reagent. The solubilities of the sulphates of several amines have been determined, but no sulphate less soluble than benzidine sulphate has as yet been found. Most of the amines examined were of higher molecular weight than benzidine, and it would seem that some other factor is opposing any weight effect. Certain empirical observations have been made, however. Thus separation of the benzene rings of the benzidine molecule in such a way that resonance between them is stopped (*e.g.*, 4,4′-diaminodiphenylmethane) results in a greatly increased sulphate solubility, but where the resonance between the rings is maintained (*e.g.*, 4,4′-diaminostilbene) a marked decrease in sulphate solubility is found. Again, monomethylation of one of the amino groups of benzidine causes an increase in sulphate solubility. Future work in this field will be based on these observations; thus, stepwise blocking of the amino groups by alkyl and aryl substitution and also by mono- and dimethine formation will be carried out. Attempts will also be made to synthesise new compounds containing resonating groupings between the rings and to study the effects of these on the sulphate-forming properties of the molecule.

Several substituted benzidine and related compounds were found to give more sensitive reactions with oxidising agents than benzidine. 3-Methylbenzidine, for example, is more sensitive towards dichromate, chromate, and vanadate, while 2,7-diaminofluorene is ten times more sensitive towards persulphate, chromate and periodate. 3-Methylbenzidine and 3,3′-diethylbenzidine may be used with advantage as indicators in place of iodide or bromide in the titration of silver with iodide or bromide in the presence of copper ions. The colour change at the end-point is very sharp, being due both to the formation of a blue complex with the benzidine type of molecule and the copper, and to the formation of free halogen which oxidises the benzidine molecule to give the characteristic blue product.

The same two compounds have proved more satisfactory as regards end-point colour change than *o*-dianisidine in the titration of mg. amounts of gold with hydroquinone. This should prove of interest in the plating industry and to public analysts in general, who are frequently called upon to determine gold in the urine of rheumatoid arthritis patients.

Generally Very Soluble

Most benzidine derivatives will precipitate tungsten and molybdenum from neutral solution. In acid solution the precipitate with molybdenum is generally very soluble, while the tungsten precipitate dissolves to a certain extent. One amine, however, 4-amino-1-(4-aminophenyl)naphthalene, was found to give a precipitate with tungsten which was difficultly soluble in 1N hydrochloric acid, while the precipitate with molybdenum was completely soluble at this acidity. Accordingly, a method has been developed for the determination of tungsten in presence of molybdenum. As little as 5 mg. of tungsten may be determined satisfactorily in the presence of ten times as much molybdenum. Ferric iron interferes, but the method should, nevertheless, prove of value to many branches of industry.

Mercurous nitrate has been used for several years as a titrant in the presence of

thiocyanate for the direct determination of ferric iron. No information was, however, available as to the stoichiometry of the reaction and the various interferences to be encountered. A study has now been completed of both these aspects and many other applications found for the reagent. The reaction was found to be stoichiometric over a wide range of concentration. Only a few ions interfered with the reaction, but these interferences could generally be overcome by using suitable masking reagents.

Oxidising agents may now be determined titrimetrically using mercurous nitrate as reagent, and certain reducing agents may also be determined satisfactorily using an indirect procedure. In this latter case, excess of a standard ferric solution is added to the solution of the reducing substance. The ferric is then reduced to ferrous and the excess ferric is then determined in the usual way with mercurous nitrate.

Potassium permanganate cannot be used as an oxidant in the presence of chloride ion. Several years ago Ubbelohde proposed manganic sulphate as an oxidant in place of permanganate. Chloride did not interfere and there were no complications due to valency changes. Unfortunately, the solutions of manganic sulphate are not stable and rapidly deposit MnO_2. Stabilisation of the reagent has now been effected by addition of pyrophosphate to form complex pyrophosphatomanganate iron. The reagent may be used in many of the permanganate titrations and, as with permanganate, acts as its own indicator.

Growing Importance

The determination of fluorine has assumed a greater importance during recent years in the fields of both inorganic and organic chemistry. A method has been developed for the determination of fluorine in organic compounds: the sample is fused in a specially designed nickel bomb with sodium metal, and the fluoride formed determined gravimetrically as lead chlorofluoride after precipitation under controlled conditions.

The determination of other elements in the presence of fluorine is a major problem in organic microanalysis. The Birmingham School has recently developed a satisfactory combustion method for the determination of carbon and hydrogen in fluorine-containing compounds. The SiF_4 formed during the combustion is removed by sodium fluoride heated to about 250°C.

An examination is being carried out of every reaction of the fluoride ion which might be exploited for analytical purposes. Countless dyestuffs have so far been examined as possible indicators n the well-known thorium nitrate titration. So far, no indicator has proved better than the original indicator, Alizarin S, which itself is unsatisfactory in many ways. Some improvement has, however, been effected in the original indicator by screening with a neutral dyestuff.

Reversible Indicators

New reversible indicators have been developed for certain oxidimetric titrations in which the conventional indicators are destroyed under the conditions prevailing at the end-point; in other words, the end-point colour change is irreversible. Such a state of affairs exists when the oxidimetric titrants, potassium bromate, potassium iodate and sodium hypochlorite are used, although a few reversible indicators are known for the first titrant. The pyrazolone dyestuff, Quinoline Yellow was found to be satisfactory for the titration of trivalent arsenic or antimony with potassium bromate. Although some slight destruction of the indicator occurs, several titrations and back titrations can be carried out before the colour becomes too faint for the end-point change to be seen.

The same compound has proved satisfactory in hypochlorite-arsenite titrations, as has the dyestuff Tartrazine. *p*-Ethoxychrysoidine may be used as a reversible indicator in titrations with iodate in place of the irreversible indicators proposed by Smith and Wilcox.

The compound hydroquinone is used as an inhibitor in polymerisation reactions, and it is often necessary to determine the amounts present at various stages of the reaction. Many possible colorimetric methods have been examined, but only one proved suitable. The method is briefly as follows: Excess of a ferric solution is added to the unknown hydroquinone solution. The hydroquinone produces an equivalent amount of ferrous iron which is then determined colorimetrically with *o*-phenanthroline after suppressing the colour of the excess ferric by addition of fluoride ion. In this way as little as 0.1 μg. of hydroquinone can be accurately determined in the presence of large amounts of methacrylic acid.

Gluconic Acid

Increasing Applications in Industry

GLUCONIC acid, the first oxidation product of d-glucose, is to-day finding increasing applications in industry where a mild, non-toxic organic acid is needed. Because of its low corrosion rate it is now being employed as an ingredient of acid type detergents used for cleaning milk cans and other kinds of metal containers. Recent experience in the brewing industry has shown that gluconic acid is invaluable for the prevention of solid deposits in tanks, lines, barrels, etc. By its use it is possible to ensure that no damage to the protective coating takes place, moreover as the acid is non-toxic there is no necessity to ensure that the last traces of acid are removed from the equipment. Particularly important from the safety angle is the fact that gluconic acid is non-hazardous to handle and splashes of the aqueous solution do not cause skin burns or any ill effect.

Important Uses

The most important uses so far found for gluconic acid may be summarised as follows :—

1. Owing to the fact that gluconic acid forms soluble metal salts and also tends to hold metallic ions in solution, even when alkaline, the acid finds uses in several fields where precipitation of metals has to be avoided. For alum tanning, the presence of gluconic acid enables adjustments to be made in the *p*H without fear of precipitating the aluminium salt. Another interesting use for gluconic acid, which exploits its ability to restrain the precipitation of metal, is found in acidising oil wells. Here the gluconic acid prevents the precipitation of iron as the acid is neutralised by the limestone.

2. In textile dyeing the presence of gluconic acid in the dye bath improves penetration and tends to give more level colours without weakening the fibres.

3. For cleaning food-processing equipment, storage tanks and cans, etc., gluconic acid not only greatly assists in removing deposits but leaves the metal surface in a slightly acid condition which is unfavourable to bacterial life. When tested on a large scale, cans cleaned with detergents containing gluconic acid were found to have a very low thermoduric and thermophyllic bacteria count while those from the more commonly employed detergents were considerably higher.

4. The electro-pickling and cleaning of metals are greatly improved by the use of gluconic acid which enables the acid consumption to be reduced and yet pickling action accelerated.

Gluconic acid is a fine white powder, but it is often marketed as a 50 per cent aqueous solution. This is a light yellow syrupy liquid having a specific gravity of 1.24 with a very slight odour and mildly acid taste. The melting point of the acid is 131°C. and it decomposes at 180°C. It is insoluble in ether and benzene, but readily soluble in water. In aqueous solutions, the acid is partially transformed into an equilibrium mixture with the gamma and delta lactones, both of which are inner anhydrides formed by the elimination of water within the molecule. As neutralisation proceeds, the equilibrium is upset and more and more lactone is transformed into the acid.

Scottish Alkali Regulations

PROVISIONS affecting the chemical industry are contained in the Alkali, etc., Works Regulations (Scotland) Act, which came into force on 1 May.

The Act empowers the Secretary of State for Scotland to make Orders extending or amending the list of chemical works and noxious gases brought under control by the Alkali Act of 1906, which provides for the registration and inspection of works likely to give off offensive fumes. Before any Order is made under the new Act, the Secretary of State must hold an inquiry and must consult the local authorities and industrial interests concerned.

The Act also enables the Secretary of State to authorise the inspection of any unregistered work that he regards as likely to cause the evolution of any noxious and offensive gas.

Change of Address

The address of the Directorate of Scientific Development branch of the Ministry of Commerce has now been changed to Chichester House, Chichester Street, Belfast, and all correspondence should now be sent to this new address. The telephone number is Belfast 28271.

The Fluid Bed & Liquid Phase Slurry Process

INVESTIGATIONS in progress at the Fuel Research Station of the DSIR may open up new possibilities for the Fischer-Tropsch process. Hitherto one of the principal difficulties limiting the economic applications of this process has been the fact that the reaction itself is highly exothermic. The liquid products are only obtainable if the reaction temperatures are kept within very narrow limits, these limits ranging from about 230 to 350°C. when iron catalysts are employed. Workers at the Fuel Research Station are examining two possible methods of improving the conventional processes, namely, the use of a fluid bed for the reactions and by using a catalyst in oil.

Formerly the search was always for a more active catalyst which would give a high conversion of the gas. With a catalyst capable of giving this high conversion, the throughput of gas must be increased in order that the maximum yield of products may be obtained per unit volume of the catalyst. If the process is run at a high throughput of gas and a high conversion rate, the amount of heat liberated increases with the gas rate and the conversion. The greater the amount of heat liberated, the more tendency there is for the catalyst to rise in temperature. Should its temperature rise above the higher limit of the reaction, oil is no longer yielded and normally the process starts producing methane or carbon dioxide or both, together with free carbon.

Fundamental Problem

The fundamental problem, therefore, has always been to remove the heat in the reaction by some method or other. The old conventional method was to make use of an extremely elaborate and expensive vessel, the consequence being that the cost of the reaction chambers was extremely high and a great deal of expensive metal was used in the construction of the plant.

A technique developed in the United States for the catalytic cracking of petroleum hydrocarbons was applied by the Americans after the war to the Fischer-Tropsch process. This technique is based on a bed of fluid catalyst in powder form, the granular sizes normally used for an iron catalyst being from about 72 to 170. If a stream of gas is blown through such a catalyst bed and the right conditions are produced, the catalyst powder can be maintained in the fluid bed and will behave very much like a liquid which is just boiling. The linear gas velocity—which is governed by a number of factors such as size and weight of the integral particles—must be just sufficient to keep the particles in motion but in a restricted space. The bed itself can be made to flow from one plant to another, exhibits hydrostatic pressure, and for most practical purposes can be treated as if it were a liquid. The essence of this technique is that the particles are in relative motion to the gas stream, a further advantage being that they tend to circulate quite rapidly.

Good Heat Transference

A system in this condition gives a very good transfer of heat from the catalyst particles to the gas stream and from the gas stream to the walls of the reaction chamber, any cooling devices being located inside the chamber. This heat transfer allows a very much larger amount of reaction heat to be removed in the same time by the fluid bed technique as compared with a fixed bed. It follows that very much larger amounts of gas can be converted to liquid products for the same volume of catalyst. At a conservative estimate, ten times as much gas per unit volume of catalyst can be converted. The fluid bed itself requires very careful control, being in a semi-stable equilibrium. Should the gas rate fall the entire bed will collapse and become a fixed bed which is incapable of removing the reaction heat. Too high a gas rate will result in loss of material from the bed and particles of catalyst would find their way into the product collection pipes. Normally it would therefore be advisable to incorporate filters or separators of some kind in the plant.

One further difficulty is presented. In most applications of the Fischer-Tropsch process the usual practice is to make the whole series of hydrocarbons from methane to wax with a carbon chain length of about

50 to 60. These higher hydrocarbons are not volatile. When working with a fixed bed arrangements can be made for the gas flow to be from the top of the reaction to the bottom, so that the liquids can drain down through the catalyst and be drawn out from the bottom of the converter. In order to keep the bed fluid, however, the gas stream must pass upwards through the catalyst bed, and it is therefore necessary for the products to be carried in the same direction as the gas flow. The consequence is that only products which are volatile at the reaction temperature which is being employed will come off from the catalyst. Any products volatilising above that temperature are left behind in the catalyst and will change the nature of the catalyst. In the case of wax, for instance, the particles will tend to stick together and the bed ceases to be fluid.

High Temperatures Used

Because of this difficulty fluid bed synthesis is usually carried out at fairly high temperatures, these being at least of the order of 300-330°C., at which temperatures the main products are low boiling materials. One of the disadvantages of operating the process under these temperature conditions is a greater tendency towards the formation of free carbon in the catalyst. That carbon forms on the surface of the catalyst particles and also inside the particles in the pore spaces. Hence, the density of the catalyst particles decreases and the fluid bed becomes higher. Some arrangement must therefore be made to avoid excessive expansion of the catalyst bed.

This problem is aggravated by the fact that carbon deposition inside the granules is inclined to explode them, resulting in breakdown of granule size, which tends to increase the loss of material from the bed and also to aggravate the fall of density in the bed. Up to a point, however, carbon formation tends to improve the catalyst.

The investigators at the Fuel Research Station are at present confining their attention to iron catalysts and are trying to develop catalysts in which carbon formation will be at a minimum.

As previously stated, in order to keep the bed from expanding too far, provision must be made for removing the catalyst once it has reached a predetermined point. The small-scale reaction at the Fuel Research Station was therefore fitted with an overflow pipe, so that the bed could never rise beyond a certain level. Normally the process would be operated with provision for the removal of catalyst by some arrangement of this nature and the addition of uncarbonised catalyst. In the small scale system at present in operation catalyst replacement has only been carried out intermittently, but in a large-scale plant, designed to produce approximately one barrel of oil per day, it will be operated continuously.

There appears to be no doubt that the fluid bed process is capable of commercial application. A full-scale plant erected at Brownsfield, Texas, has recently been completed, though production has not yet been reported. Advantages of the process are increased output in a given reaction space, with a corresponding reduction in cost. The main expense, however, is not on the production side of the oil but in the cost of the synthesis gas applied to the plant, which is about 75 per cent of the total production cost. The cost of synthesis gas depends, of course, on that of the raw material from which it is obtained. In Britain this material is necessarily coal, with very small possibilities of peat. A plant built in the United States is designed to use natural gas, which is converted to synthesis gas by partial combustion to give the mixture of carbon monoxide and hydrogen.

Most Important Contribution

A considerable amount of work has been done elsewhere on the production of synthesis gas. The most important contribution towards making the fluid bed process economic is obviously to reduce the cost of the gas. The process is therefore most likely to be economic in parts of the Commonwealth where coal is relatively cheaper than it is in Britain. Countries for which it might well prove particularly suitable include South Africa and Southern Rhodesia, or even Australia, where there are large reserves of brown coal that can be very cheaply mined. Part of the function of the Fuel Research Station is to examine the process from the standpoint of the Commonwealth as a whole.

The other new process under examination is based on a principle which is broadly similar to that of the fluid bed technique. A fairly small size of catalyst is again used and is suspended in a liquid medium, but in

this case oil is used instead of the gas phase itself, the gas being bubbled through a slurry of catalyst in oil. This method is not as far advanced as the fluid bed process, but sufficient is already known to justify the assertion that, so far as space-time output is concerned, it is much more efficient than the fixed bed system, though it is still doubtful whether it will be as satisfactory from this point of view as the fluid bed process.

An important advantage of the liquid phase slurry process is its greater flexibility. Since the fluid bed process must be operated at a high enough temperature to ensure high volatility of the products, its output is to a very large extent limited to the petrol range. It is capable, however, of yielding petrol of much higher grade than the old Fischer-Tropsch process, 80 octane petrol being obtainable quite easily with some refining. The liquid phase slurry process is not confined to products of high volatility, but, if desired, could produce a fairly large proportion of wax or high-boiling oils. By varying the process variables the products themselves could, of course, be varied within limits, so that both low and high boiling products could be made.

High Rate of Conversion

The fluid bed process is mainly run with a very high rate of conversion, almost complete conversion being, in fact, obtained. The temperature employed in the fluid bed in order to obtain the high volatility products necessary to keep the bed from blocking is higher than the temperature which is actually needed to give that conversion. As a result, there is a tendency towards the formation of more methane than is desirable. The slurry process has the advantage of giving smaller yields of methane.

Both processes are at present being operated under similar conditions at the Fuel Research Station. In each case the catalyst used is an alkalised iron oxide, which is reduced in hydrogen before use and is both easy and relatively inexpensive to produce. The operating pressures used for both processes are in the range of 20-50 atmospheres. The liquid phase slurry process, however, has been operated between 250 and 330°C., thus benefiting from a reduction of 50° as compared with the fluid bed process. Operation at the lower temperature tends to yield a larger proportion of high-boiling materials. So far, none of the difficulties resulting from carbon formation has been experienced. Not enough work has yet been done on the liquid phase slurry process to warrant an assessment of its economic possibilities.

The large-scale plant now under construction is expected to start production during the current year. It will be used in the first place for the fluid bed technique, but once this process has been well established it is proposed to design a converter for the liquid phase slurry process, which will be interchangeable with that used for both processes. By similar means it will be possible to use the large-scale pilot plant for studying any other techniques which may require investigation.

Should Yield Valuable Information

It is hoped that the construction of a plant of this size will yield much valuable chemical engineering information. Since the iron catalyst used results in the formation of an appreciable proportion of oxygenated compounds, there will also be certain chemical aspects to consider. With the fluid bed process, for instance, from 25 down to 10 per cent. of compounds which are non-hydrocarbons are obtained, among them being alcohols, ketones, acids, esters, etc. The majority of these compounds are recovered from the reaction water, from 35 to 40 per cent of the oxygenated derivatives being ethyl alcohol. Possibly the yield of this compound could be increased, but this aspect of the chemical possibilities has not yet been studied. The remainder of the hydrocarbons could, of course, be converted to chemicals, if desired.

Apart from methane, there is a certain proportion of volatile hydrocarbon gases, which are usually converted to polymer petrol and then mixed with the normal straight-run product from the plant.

Even under wartime conditions in Germany relatively few attempts were made to recover the oxygenated products from the cobalt catalysts employed. Now that iron catalysts are being used, however, and more especially with the fluid bed technique, much more attention is being given to these oxygenated derivatives. The tendency seems to be to consider them as products, isolate them, recover them, and sell them as such. As a result of the higher temperatures the fluid bed process gives a high proportion of olefines, which makes it possible to obtain gasoline of higher octane number.

Tar Oils for Potato Spraying

Substitute for Sulphuric Acid

COLLABORATIVE research by the DSIR and the Agricultural Research Council has recently shown that certain tar oils may be useful substitutes for sulphuric acid for potato haulm destruction, a purpose for which over 10,000 tons of acid a year are used.

During the war, the Chemical Research Laboratory, DSIR and the ARC sought for an effective substitute for sulphuric acid for potato haulm killing. A number of emulsions were made from coal tar phenols and field trials were carried out in Scotland and England. Some of the emulsions proved very effective. The disadvantage was that these emulsions were about three times as expensive as sulphuric acid, thus increasing the cost of spraying by over £1 per acre. The work was dropped towards the end of the war.

In 1947 the DSIR Scottish Office, considering research projects which might be useful to Scotland, called the attention of Scottish tar distillers to this work and suggested that it should be started again. Although there was, at that time, no pressing reason for the investigation it was realised that an alternative to sulphuric acid would be of great importance if sulphur were to become scarce again.

Suppliers of the high-boiling tar acids (Scottish Tar Distillers and the Glasgow Corporation Gas Department) and the spraying contractors co-operated with the CRL, the ARC, the Department of Agriculture for Scotland and the East of Scotland College of Agriculture in a small series of trials in 1949. In view of the increasing importance of low volume 'atomiser' spraying it was decided to include tests of unemulsified tar acids used neat. The results were promising and it was decided to carry out further trials with these in 1950.

Suitable for Atomisers

The director of the CRL suggested that the whole unrefined fraction of the tar oils containing the phenols would be suitable for use in the atomisers and might be as effective as the distillates. If this were so, the cost could be reduced by cutting out the expensive process of extraction of phenols. No information was available on this compound but it was thought the tar oils might taint the potatoes or damage the soil. A pilot experiment was carried out by the ARC at Sutton Bonington, Leicestershire, and was successful. The unrefined tar oil was, therefore, included in the 1950 field trials.

The unrefined tar oils were effective in killing the potato haulm, they were easier and more pleasant to handle and did not clog the nozzles of the machine; their cost was comparable with the current price of sulphuric acid, and they were also fairly plentiful.

It is considered that these oils are unlikely to have ill effects on the soil, for bacteria soon break them down. In cooking tests carried out on treated potatoes by the ARC and the Ministry of Food experimental kitchen, no indication of taint were detected. There is no risk of corrosion of spraying equipment.

It appears at the moment that any tar oil may be effective provided that it contains not less than 25 per cent tar acids of which at least 90 per cent boil in the range of 230-300°C. but further trials during the coming season will show if this boiling range can be extended at either or both ends.

Remarkable Results

IT is reported that Shell D-D (dichloropropane-dichloropropene) is achieving remarkable results as a soil fumigant and pest controller. It is said to be finding an increasingly wide field of application both in the United Kingdom and abroad, particularly in the control of various species of eelworms and termites, although it is also most effective when used against wireworms, crickets, cockchafers and weed growth.

The fumigant, which was evolved in 1942-43 by Shell chemists in the United States from what was until then a mere waste product of petroleum chemicals, is injected into soil known or suspected to harbour the pests, at least four weeks before crops are planted. A special hand-operated Injector Gun is used on small plots and various types of tractor-mounted or tractor-drawn equipment are available for large-scale application.

Element No. 61

by A SPECIAL CORRESPONDENT

THE group of fifteen chemically similar elements known as the Rare Earths, which, in the periodic table, occur between barium in Group II and hafnium in Group IV, contains fourteen symbols and one number. The number, 61, is used to denote an element whose claim to existence until recently was still precarious, although it has been strengthened very greatly in the last few years. What follows is an account of the history and the future of this elusive element.

The rare earth elements are all accommodated in the position of lanthanum in the Periodic Table. They are: La, Ce, Pr, Nd, 61, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu. It was Moseley's[1] work in 1914 which showed that an element with atomic number 61 should exist between neodymium and samarium. This naturally started an exhaustive search for the element, and the favourite places to look for it were in compounds of neodymium and samarium; these were the two elements which would resemble it most closely and in which it might be expected to occur as an impurity.

Spectrograph Used

The favourite tool was undoubtedly the spectroscope; it had long ago shown its capabilities for discovering new elements. Bunsen and Kirchhoff had discovered rubidium and caesium, other chemists using the spectrograph had discovered helium, gallium, indium and thorium, and the most prolific successes of the instrument had actually occurred among the rare earths themselves, for thulium, neodymium, samarium, praseodymium, holmium, ytterbium and lutecium had all been discovered by the use of the spectrograph. It was not therefore surprising that the same powerful tool was brought to bear on the search for element No. 61, a search that was prosecuted as soon as it was realised that there might be such an element to be found.

No doubt the spectrographers, secure in the sensitivity of their instruments, tackled the search confidently, but the problem proved to be of quite unforeseen difficulty.

This was all the more unexpected because previously it had been found possible, almost a matter of routine, to discover hitherto unknown elements whose existence was indicated by the periodic classification. Mendeleieff's prediction of the existence of eka-aluminium, eka-boron and eka-silicon was triumphantly vindicated by the discovery of gallium, scandium, and germanium, all of which had properties almost identical with those forecast. Yet element No. 61 proved far more elusive; expert chemists spent 20 years of their lives looking without any very positive success for evidence of the existence of this element.

Monazite the Source

Monazite sand is the main source of neodymium and the most likely place in which to find its close relation, element 61. Monazite itself is a rare mineral which occurs in some granites and other rocks in such small quantities that it is not worth extracting: owing, however, to the excellent resistance of monazite to decomposition and weathering, this mineral survives conditions which erode most others and accordingly there is a tendency for monazite to concentrate in river and beach sands.

Most of the monazite sand comes from Travancore in Southern India. Its main constituents are the phosphates of thorium and those of the rare earth metals cerium, lanthanum, praseodymium and neodymium. The mineral is found on the beaches as rounded grains which are honey coloured and translucent; it may contain up to 20 per cent of neodymium (estimated as oxide Nd_2O_3), and so it is clearly a very likely source in which to find element No. 61, provided of course that this element does exist in nature.

Various workers therefore carried out investigations of monazite sand; the general idea was to try to fractionate further the neodymium or samarium fraction. In 1926 J. A. Harris and B. S. Hopkins[2] carried out the fractional crystallisation of the magnesium double nitrates of the ceria earths and secured what they believed to be a concentration of element No. 61 between the neodymium and samarium fraction. However, the amount present was too small to make its detection certain by X-ray spectra and attempts to identify it my its absorption bands were inconclusive because both neodymium and

samarium themselves have broad bands capable of masking those believed to belong to element No. 61.

A separation through the bromates of the rare earths gave the following series: Nd, Tb, 61, Gd, Sm. Terbium has but one absorption band and gadolinium has none, so that it was possible to examine the absorption bands of element No. 61 without undue interference. Strong bands at 5830, 5816 and 4520 Å were attributed to element No. 61 as were also some weaker bands.

Corroboration Sought

Other workers, probably stimulated by the conviction of Harris and Hopkins that they had identified the missing element, carried out work along similar lines. Cork, James and Fogg[3], for example, examined the neodymium concentrates from large quantities of monazite sand and estimated that the oxalates of these concentrates contained from 1-1½ per cent of the oxalate of element No. 61. Rare earths are usually first separated as oxalates; it is one of the characteristics common to the rare earth elements to have insoluble oxalates.

The work of Harris and Hopkins continued with the collaboration of Yntema and these workers endeavoured to convince the chemical profession that element No. 61 had been positively identified. Although general and implicit acceptance was never accorded to their views, they succeeded in bringing forward evidence which required and deserved serious consideration. This evidence on which Harris, Yntema and Hopkins[4] based their claim to have discovered the element was as follows:

1. The presence of lines in the arc spectrum of materials prepared by them common to both samarium and neodymium and stronger in intermediate fractions. These consisted of 130 lines in the red and infra-red and five lines toward the violet. It is clear that if element 61 is to be found as an impurity in the two elements which most clearly resemble it, *viz.*, neodymium and samarium, one might reasonably expect to find lines common to the spectra of both these elements, these common lines in fact being truly attributable to neither of these two elements but to their common impurity —element No. 61.

2. The presence in their intermediate fraction of absorption bands which became stronger as the characteristic bands of neodymium and samarium became weaker. The bands at 5816 Å and 5123 Å are especially prominent and their positions confirm the belief that th.re is a systematic drift in the absorption bands of the rare earth group,' they said.

3. The presence of lines in the X-ray emission spectrum corresponding closely to the calculated wave-lengths of element No. 61—calculated from the structural characteristics of its atom.

Looking back on their work in the light of later knowledge it seems not unlikely that Harris and his colleagues did actually concentrate traces of element No. 61, which occurred naturally in neodymium and samarium minerals, into certain fractions, but even in their concentrates the proportion of the element must have been low, and there was never any prospect of being able to isolate either the element or one of its compounds, free from neodymium and samarium. In fact, the existence of the element No. 61 in these fractions, although it was extremely probable, can hardly be maintained to have been unequivocally established.

In the same year Rolla and Fernandes[5] undertook a search for element No. 61 in a small quantity of a mineral containing didymium (at one time thought to be elementary but long since recognised as a mixture of neodymium and praseodymium). They tried various methods of separation but all of them involved numerous and laborious crystallisations; in one series of experiments, for example, they carried out 3,000 crystallisations to obtain residues which indicated the presence of the element through anomalies which these residues showed in their absorption spectra.

Existence Confirmed

These workers welcomed the publication of the contemporary work of Harris, Yntema and Hopkins as confirming their own results and 'rendering certain' the existence of element No. 61. Subsequently, however, they came into conflict with them on the question of the name that should be given to the new element.

Later work on the identification of the new element continued over a period of many years in different laboratories. In 1933, for example, Hughes and Hopkins[6] investigated the basicity of element No. 61 by fractional precipitation with sodium nitrite and placed it as shown in the following series: Pr, Nd, 61, Y, Sm.

The lack of clear-cut decisive evidence to establish the existence of the element, however, slowly wore down the early faith that the element would be isolated soon after its existence was predicted, and doubt began to enter the minds of chemists. Jensen[7], for example, in 1938, from theoretical considerations of the structure of the atom of No. 61, adduced reasons for doubting whether it could exist with a stable nucleus. The whole position was clouded in uncertainty, but the problem continued to attract the attention of chemists, and it was not long before the new technique of chromatographic adsorption was brought to bear on it.

In 1946, Lindner described a method of separation of various elements by chromatographic adsorption on alumina. At first the method was employed to separate radium from barium but later it was claimed that element No. 61 could easily be separated from samarium, which was very strongly adsorbed; there was, however, stated to be very little difference in the adsorption of element No. 61 from that of either praseodymium or neodymium.

First Real Identification

Probably the first unambiguous announcement of the identification of the unknown element was made by C. D. Coryell in April, 1946, at the symposium on nuclear chemistry at Atlantic City, when he revealed that in work on the radioactive fission products of the uranium pile, clear identification had been obtained by several workers of an isotope of element No. 61 with a half life of 3.7 years. It was stated to be formed by the β-disintegration of a neodymium isotope which had a half life of 11 days, the isotope of element No. 61 itself decaying into a stable samarium isotope.

A little later in 1948 Marinsky and Glendenin[9], who had worked under Coryell, confirmed (*Chem. Eng. News*, 1948, *26*, 2346) that milligram quantities of the 3.7 year radio-isotope of element No. 61 were available at Oak Ridge; this isotope had a mass of 147. It seems, too, that another isotope of element No. 61, one with a mass of 148 and a half-life of 5.3 days, has been positively identified by means of ion-exchange methods by Parker, Lantz, Inghram, Hess and Hayden[10]. 'There is,' according to Marinsky and Glendenin, 'also the possibility of the existence of a very long-lived isotope of one of the known isotopes of element No. 61, which, from a practical standpoint, could be classified as stable. The possibility that a very long-lived isotope of element No. 61 exists must, therefore, be considered. In addition, the occurrence of a radioactive Nd isotope in nature, which may decay by β-emission to a radioactive isotope of element No. 61 is also a matter for consideration.'

Paneth's Rules of Nomenclature

In 1947 Paneth[11] discussed the question of naming new elements, and concluded that in view of the output of a uranium pile including relatively large quantities of elements which probably occurred naturally in traces, there was no longer any good reason to distinguish between naturally occurring and artificial elements; if the former were entitled to names, so were the latter. He instanced the case of element number 94 (plutonium) of which many pounds had been prepared in a uranium pile; this element, which is one of those known as trans-uranic, must, according to Paneth, always be expected to accompany natural uranium in minute proportion. Paneth, therefore, enunciated the following rules for the naming of a new element:

1. The right to name an element should go to the first person who gives definite proof of the existence of one of its isotopes.

2. In deciding the priority of the discovery, there should be no discrimination between naturally occurring and artificially produced isotopes.

3. If a claim to such a discovery has been accepted in the past but is refuted by later research, the name should be deleted and replaced by one chosen by the real discoverer.

Paneth urged that names should be provided for elements 43, 61 and 85. 'Every chemist concerned with the task of teaching systematic inorganic chemistry and of keeping his table of the Periodic System up to date will be grateful if they (the discoverers) will publish soon the names which they consider suitable.'

Harris, Yntema and Hopkins[4] had claimed to have identified the element and as they had carried out their work at the University of Illinois, they proposed 'the name of Illinium with symbol Il for this element, in honour of the State of Illinois and of our University.'

Rolla and Fernandes[9], however, had been carrying out work on Brazilian monazite and they also claimed to have identified element No. 61. By virtue of a sealed communication deposited in 1924 they claimed priority for the discovery, and proposed[12] the name Florentium and the symbol Fr for the new element. The name Florentium was chosen because Rolla of the University of Florence had played a leading part in the discovery of the element.

Disagreement on Names

Loyalties to *alma mater* must have been strong in 1926. There followed quite naturally a spirited controversy as to whether Illinium or Florentium should be immortalised. Noyes[13] came down heavily in favour of Illinium while Rolla and Fernandes[14] claimed to have named the element Florentium some twenty months earlier than the name Illinium was published. They were 'on the other hand, perfectly in agreement with Professor Noyes that much additional work has still to be done on the subject' and they hoped 'that the combined effort of researches' would in a short time, 'bring about the undisputed acceptance of the new element.'

In the end, the discussion was sterile, for the chemical world was not convinced that the existence of the element No. 61 had been established beyond doubt. Chemists still felt that it was safer to use the number 61; as this involved no heavy commitment, whatever revelations future work might make. In any case, no one doubted Moseley's statement that this element should exist between neodymium and samarium in the periodic classification.

Later, when element No. 61 had been definitely identified and prepared in milligram quantities at the Clinton National Laboratory, Oak Ridge, Tennesse, Marinsky and Glendenin[9] of the Massachusetts Institute of Technology, suggested the name Prometheum for the element, subject to the proviso that when the absorption spectra of the Tennessee sample were examined, they refuted and did not confirm the earlier work of Harris *et al.* Marinsky and Glendenin wrote, 'We propose, therefore, the name 'Prometheum' (symbol Pm) for element 61 after Prometheus, the Titan in Greek mythology, who stole fire from heaven for the use of mankind. This name not only symbolises the dramatic way in which the element may be produced in quantity as a result of man's harnessing of the energy of nuclear fission, but also warns man of the impending danger of punishment by the vulture of war.' It is not exactly gossamer stiff, but poets, unlike Prometheum, are born, not made.

'Cyclonium' was another name that was proposed in 1943; this one by Pool and Quill[15], who claimed to have obtained element No. 61 by bombarding praseodymium with α-particles; their claim received some support from Gould[16] but apparently the claim was not pressed and 'Cyclomium' seems already forgotten. 'Prometheum' has been adopted by the American Chemical Society.

Although element No. 61 has hitherto proved scarce, and has in fact been sought with great assiduity by those research workers who wished to establish its existonce beyond doubt, it may well be that soon there will be more of it in evidence than is either required or desired.

Details of Absorption

According to Tamilton[17], element No. 61 with an atomic weight of 147 occurs among those products of nuclear fission which have a long life. Hamilton gives particulars of its absorption and elimination from the rat which was used as an experimental animal. There is initially a high degree of accumulation by the liver, but if dosage is discontinued element No. 61 is eliminated rapidly, actually in about 10 days, from this organ. There is also a slower but greater accumulation of the element in the bones, and the time taken for elimination from the skeleton is much longer, of the order of 100 days. Unlike radio strontium which is deposited almost uniformly throughout the bone, element No. 61 is deposited more superficially. Only a negligible degree of absorption takes place through the digestive tract, but the danger of inhalation may be much greater; direct trials have not been made but if assessed by comparison with plutonium inhalation experiments, it certainly is so. It has to be remembered that whereas radium has a half-life of 1,600 years that of element 61 ^{147}—which has one of the longest half-lives of the fission products—is only 3.7 years.

Another factor to be taken into consideration is that 61 ^{147} decays by β-emission, and that β-particles are considerably less

[continued on page 782

Chemistry & Concrete-Making

New Structures Laboratory Opened at Wexham Springs

MUCH valuable research and development in the many and varied fields in which cement is used has been carried out by the research station of the Cement and Concrete Association since its establishment at Wexham Springs, near Slough, in 1947.

The first important addition to the buildings is the structures laboratory which was officially opened on 10 May by Mr. G. A. Brown, Minister of Works, in the presence of a large gathering which included many well-known scientists and engineers.

Problems relating to structural design will be specially studied in the new laboratory which cost £32,000 and contains ingenious equipment valued at £5,000. One feature, the specially designed test floor, is probably unique.

Processes undertaken in chemical works frequently require special structure and this laboratory, in which it is the intention to bring together theory and behaviour in practice so that each may be checked and proved the one against the other, should be a source of valuable information to the chemical industry.

The research station has, of course, its own physics and chemistry section which studies the fundamental aspects of various problems involved in the behaviour of cement and concrete and is also responsible for the development of physical and electrical apparatus required in the research work of the other sections.

Three Main Groups

Work of the physics and chemistry section falls mainly into three groups:—

Technical service to the concrete-making industry in response to inquiries received by the London office; assistance to other sections on the research station; and research.

Technical service consists of investigation of day-to-day problems arising from the use of Portland cement in industry. These do not as a rule involve extensive investigation and can frequently be solved quickly by experience, coupled with a few laboratory tests. In the case of concrete which has failed, it is possible by analysis to obtain certain information which is helpful. Thus, the cement-aggregate ratio can be determined with fair accuracy. The concrete can be broken down so as to release the aggregate which can be sieved to determine if it is properly graded.

Where chemical attack has taken place, attacking agents usually leave traces which can often be recognised. From experience and knowledge of the properties of concrete it is now possible to give reliable advice about the effect corrosive agents are likely to have on concrete structures.

Special Analytical Staff

Since the bulk of this work involves chemical analyses, a laboratory has been set apart for the purpose and its staff specialise in inorganic analysis, particularly that of silicates and calcium components. A special study is being made of semi-micro colorimetric methods for analysis of silicates using the Spekker absorptiometer.

Assistance to the other sections of the research station is given by both the physical and chemical laboratories. The chemistry laboratory makes routine analyses of cements used for research projects; it also analyses other materials about which information may be required. The laboratory supplies to other sections any materials which need compounding or dispensing accurately.

Certain of the tests in the common cement specifications are also made as required, in particular, determination of specific surface, soundness and fineness. Non-standard tests needed for special materials are devised and made as necessary.

The physics laboratory provides facilities for measurement and is intended in time to include a standards section which will house instruments for the calibration of measuring apparatus used on the station.

In addition, there is a small laboratory in which new instruments are developed, and apparatus which cannot be purchased ready-made from regular manufacturers is constructed. Items of apparatus recently produced in this laboratory are:

(1) An instrument for the non-destructive examination of reinforced concrete,

which indicates the position of the reinforcement inside the concrete.

(2) Apparatus for determining the elasticity of concrete by an electrodynamic method.

(3) Apparatus for measuring the stress in stretched steel wires used in pre-stressed concrete.

(4) Oscilloscope for display of output from strain gauges, used to facilitate frequency comparisons for strain measurement.

An investigation is in progress to discover the causes of efflorescence on concrete. This phenomenon is probably caused by the formation of calcium carbonate on the surface of concrete by reaction of calcium hydroxide from the interior of the concrete with atmospheric carbon dioxide. There are a large number of variables involved in the formation of the efflorescence film and an attempt is being made to study them singly in order to discover which of them is primarily responsible.

A study was also made a short time ago of the effects of commercial surface-active agents on the properties of concrete mixes. Some of these substances are marketed as air-entraining agents and as they are of an organic nature it was considered worth while finding out whether they had any effect on the setting time of cement. The substances examined were found to have a negligible effect on the rate of hydration and setting times of ordinary Portland cements when used in the proportions recommended to induce air-entrainment.

It is proposed to study the hydration of Portland cement with the object of obtaining as complete a picture as possible of the micro-structure of hardened Portland cement pastes.

Examination of the detailed form of a hydrated cement paste can be made by a variety of physical and chemical methods and its nature deduced from its properties. For this purpose the techniques of electron microscopy and electron diffraction, studies of permeability and water absorption, have been found valuable in previous work and will be employed as necessary.

The study of dimensional changes in hardened concrete is of great interest and information about the mechanism of moisture movement, crazing, and creep of hardended concrete is needed for use in designing concrete structures.

Element No. 61

continued from page 780

dangerous than α-particles. Hamilton's paper, although it contains vastly more information than is given here, is of a preliminary and exploratory nature, but it does seem to give some reason to hope that the toxic hazards associated with the formation of fission products in the uranium pile may be more manageable than was at one time thought.

As Hamilton himself concludes 'it should be said that there is no new major mystery surrounding the problem of protection against the radioactive products associated with the release of atomic energy. The physical phenomena of radioactivity and its biological actions have been known and subjected to intensive investigation for half a century. Recently consideration has had to be given to a much larger quantity of radioactivity arising from a somewhat greater number of radioactive elements than those which occur normally in nature. Although some of the problems presented by this new situation are formidable, to say the least, in retrospect many other equally formidable problems have been successfully passed by those working in the medical and related biological sciences.'

REFERENCES

[1] H. G. J. Moseley. *Phil. Mav.*, 1914, *27*, 703
[2] J. A. Harris and B. S. Hopkins, *J. Am. Chem. Soc.*, 1926, *48*, 1585.
[3] Cork, James and Fogg. *Proc. Nat. Acad. Sci.*, 1926, *12*, 696.
[4] J. A. Harris, L. F. Yntema and B. S. Hopkins, *J. Am. Chem. Soc.*, 1926, *48*, 1594.
[5] L. Rolla and L. Fernandes, *Gazz. chim. ital.*, 1926, *56*, 435-6.
[6] Hughes and Hopkins, *J. Am. Chem. Soc.*, 1933, *55*, 3121.
[7] Jensen, *Naturwissenschaften*, 1938, *26*, 381
[8] R. Lindner, *ibid*, 1946, *33*, 119-21; 369-70.
[9] J. A. Marinsky and L. E. Glendenin, *Chem. Eng. News*, 1948, *26*, 2346.
[10] G. W. Parker, P. M. Lantz, M. G. Inghram, D. C. Hess and R. J. Hayden, *Phys. Rev.*, 1947, *72*, 85.
[11] F. A. Paneth, *Nature*, 1947, *159*, 8.
[12] L. Rolla and L. Fernandes, *Gazz. chim. ital.*, 1926, *56*, 862-4.
[13] W. A. Noyes, *Science*, 1927, *65*, 160.
[14] L. Rolla and L. Fernandes, *Nature*, 1927, *119*, 637-8.
[15] Pool and Quill, *Phys. Rev.*, 1943, *63*, 463.
[16] R. F. Gould, *Chem. Eng. News*, 1947, *25*, 2555.
[17] J. G. Hamilton, *New England J. Med.*, 1949, *240*, 863-70.

Asphalite Mining

The Argentinian National Department of Solid Mining Fuels has commenced mining asphalite in the province of Mendoza and expects initial production to be about 600 tons per month.

Biochemistry & Sulphur

Boot Foundation Lecture Published

THE sudden blossoming into the news of that commonplace but elusive element, sulphur, and what mankind does with it, makes it interesting to recall how indispensable sulphur is to the body and what Nature uses it for. A lucid sidelight on one aspect of this was given in the 23rd Sir Jesse Boot Foundation Lecture, 'Biochemistry and Sulphur,' delivered on Friday, 12 May, 1950, by Professor R. A. Peters, M.A., F.R.S., which recalls in a most readable manner, if a trifle sketchily, the history of the search for an antidote to arsenical war gases in 1939-40, such gases being found to act on the sulphur groupings in living tissue. The importance of this search and its successful conclusion is not only that it has made the arsenical gases useless in warfare, but that it has brought to light several interesting facts about the function and behaviour of sulphur compounds in the living body, and helped us to understand the mode of action of many metallic poisons on living tissue, and nature's methods of fighting them.

Professor Peters begins his lecture by outlining the form that sulphur compounds take in the body. Many fundamental biochemical processes depend on the thiol-disulphide equilibrium, and three principal amino-acids, glutathione, methionine and cysteine, as well as many enzymes—nature's catalysts —contain sulphur in either the —SH or the —S—S—form, and the nitroprusside reaction enables us to tell which form it is. Sometimes these compounds are interchangeable by oxidation or reduction, but at other times the particular enzyme or hormone irreversibly loses all its activity the moment its sulphur groupings are interfered with. The important point with regard to arsenical poisoning is that these thiol groups (—SH) do not have the same reactivity in all molecules, some being attacked and combined with more readily than others. On this fact depends not only our own methods of countering metallic poisoning, but also nature's defences of the body.

Ehrlich's Discovery

It was the great Ehrlich who originally suggested as long ago as 1909 that —SH groups might be the arsenic acceptor in living tissue, and events have proved him right. Professor Peters describes the first work of his own with arsenical compounds back in 1917. Aromatic compounds, he found, were more toxic than aliphatic, and secondary or di-substituted more so than primary or mono-substituted. No explanation of this, however, was discovered until more than thirty years later.

Hopkins Gave the Key

Hopkins' work on glutathione, says Professor Peters, gave the key to the action of the arsenicals. Diphenyl-chloro-arsine abolished the free —SH groups in glutathione, as shown by an absence of colour in the nitro-prusside test, thereby showing that the arsenic acted by combining with an —SH group to form a thioarsenite. Later, more important work showed that this combination was a reversible one and that the thioarsenites formed did not all have equal stability, the arsenic sometimes reacting preferentially with an excess of another —SH compound injected into the body, and hence protecting the body tissue from arsenic for the first time.

The missing link in the problem was to find out where in the body's natural cycle the arsenic acted to such ill effect. Professor Peters discovered a clue to this in 1935 when working on the action of thiamin or vitamin B_1—another compound of sulphur. He found that this acted catalytically at a certain stage in the breakdown of sugars in the body—where pyruvic acid is converted into other products. Arsenicals such as Lewisite acted precisely at the same stage, its presence inhibiting further metabolism of the pyruvic acid and causing an accumulation of the acid in the blood.

In 1939 Professor Peters and his team set to work on the bold assumption that Lewisite not only acted by neutralising —SH groups in tissue, but also that these —SH groups were to be found in some specialised protein of an enzyme system which was concerned with the catalytic conversion of pyruvic acid. The plan worked. Lewisite was found to act selectively on enzymes, and these enzymes were found to possess free —SH groups. Such a startling discovery as

this, together with the knowledge that such action was reversible, made it certain that all that was required to neutralise the Lewisite was injection of excess of a harmless compound containing —SH groups, like glutathione or cysteine, for the arsenic to be removed from its damaging association with the tissue component by mass action alone. This method was tried. It failed completely.

'Valley of Darkness'

Professor Peters describes the ensuing period as a valley of darkness. Light eventually came, however, by a piece of pure chemical work. His team were making compounds of Lewisite with kerateine—another amino-acid in hair containing —SH groups—and analysing them for arsenic, when they found that the number of —SH groups disappearing as the Lewisite combined was far greater than the number of arsenic atoms entering the molecule. This led to the crucial idea that the stability of this compound was due to ring formation and that the arsenic atom formed a ring with a dithiol. This theory explained the ineffectiveness of injection of a monothiol like cysteine or glutathione, because the arsenical would not detach itself from a stable ring compound with the enzyme in favour of a less stable straight-chain compound with the antidote. Consequently a dithiol was introduced into the blood—$CH_2SH.CHSH.CH_2OH$ (called British anti-Lewisite, or BAL)—and this not only inhibited the action of Lewisite when added at the same time as the arsenical, but reversed it when added up to two hours afterwards, thus proving the important point that the actions of this type of poison are reversible. Moreover, not only was BAL found to be effective in the rare cases of poisoning by arsenical drugs, but it was found to be equally effective in the cases of poisoning by gold, antimony and especially mercury.

In 1947, points out Professor Peters, a BAL glucoside was prepared which, as a water-soluble substance, remains in the blood, thereby being less toxic than the fat-soluble BAL itself. The weapons we now possess against arsenical poisoning consist therefore of a fat-soluble dithiol which will penetrate into the cell and a water-soluble one which will remain in the blood.

An interesting point is raised by Professor Peters when he says that the di-substituted arsenicals, such as diphenyl-chloro-arsine, which cannot form ring compounds with dithiols, are also very poisonous under certain circumstances. This raises the question that there must exist in the body a very stable thioarsenite with this compound, and such a thioarsenite has actually been identified with a certain monothiol enzyme. The fact that the monothiol amino-acid glutathione reverses the poisoning of this enzyme shows that the di-substituted arsenicals act in a similar way to the mono-substituted, but that they form straight-chain arsenites instead of ring compounds. In possessing a natural supply of glutathione, the body protects itself against the most poisonous arsenicals, and the fact that diphenyl-chloro-arsine irritates the nerve-endings in the lungs suggests that there is not enough glutathione present there to counteract it. The di-substituted arsenicals have no such natural antidote and take advantage of a seeming gap in the body's defences.

The interest that attaches to this research, as Professor Peters points out, lies in the fact that this is one case at least where science has reversed its own capacity for damage. Moreover it is an unusual instance of the finding of a therapeutic agent by a theoretical approach. Its main importance, however, and one which may prove very valuable to biochemistry, is that we have learnt the biochemical fact that there is some important protein with two —SH groups arranged adjacently in space. Such discoveries are the beginnings of structural elucidation that must precede any theoretically based attempts to find out the modes of action of natural substances.

Copies of Professor Peters' lecture may be obtained on request from the Registrar, University of Nottingham.

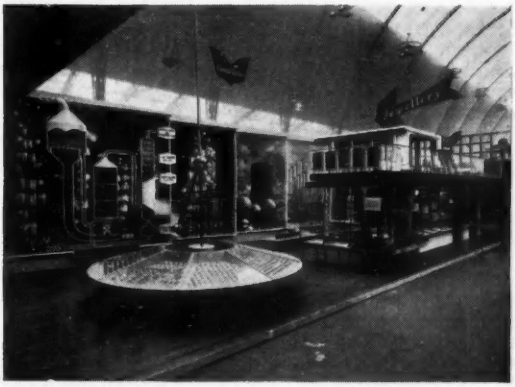
£35,000 Gift to College

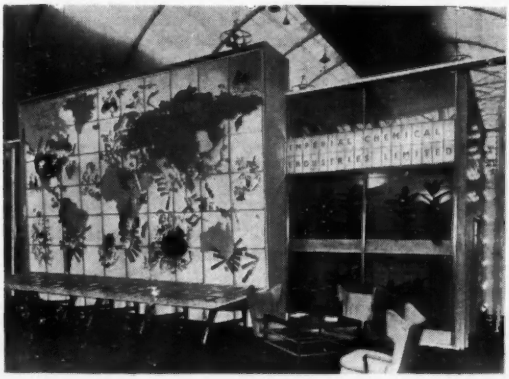
Mr. T. W. Lyle, general manager of Scottish Oils and Shell Mex, Ltd., recently announced that a gift of £35 000, spread over seven years, was to be made towards the extension fund of the Royal Technical College, Glasgow, by the Anglo-Iranian Oil Company and a company of the Shell group. It is understood that each of the companies will contribute £2,500 a year over the next seven years.

British Industries Fair

NEARLY 3,000 exhibitors took part in the British Industries Fair which closed last week. The greatest problem with which manufacturers had to contend was the raw material shortage, existing or threatened, and the consequent inability to give the earlier deliveries which overseas buyers have recently come to expect.

In the chemicals section at Olympia it was confirmed that there was a big opening in the U.S.A. for any manufacturer who could give speedy deliveries. A Watford firm's tung-oil substitute was much in demand.





Above—A general view of the Shell stand. Left—The main stand of I.C.I. at Olympia showing its great overseas organisation. Below—Hickson & Welsh's stand at Olympia exhibiting a wide range of chemicals

as also were microscopic stains and reagents. Exceptional overseas business was reported by a maker of home dyes.

At Earls Court plastics machinery sold well. One manufacturer had to display 'Sold' notices on all his machines only six hours after the opening.

The main demand at Castle Bromwich was for capital equipment. Some makers of heavy engineering plant had to lengthen considerably their delivery rates, while others had even closed their books and were showing for prestige.

C

Sulphur from Petroleum

To Build Plant in Alberta Oil Fields

CANADIAN sulphur produced from petroleum will be supplied to the British Columbia pulp and paper industry for the first time in the near future, according to an announcement made jointly by Powell River Co. and the Shell Oil Co. of Canada.

First Canadian plant to help the pulp and paper industry's sulphur shortage from petroleum will be built by Shell Oil Co. of Canada at Jumping Pound field, 30 miles from Calgary, according to its president, W. M. V. Ash.

This statement followed quickly on reports from Washington that a sulphur shortage would curtail newsprint production and that sulphur was likely to be allocated in the U.S.A. Demands for sulphur, essential to production of newsprint and rayon, have been exceeding supply by from 15 to 20 per cent. The Dominion is not producing elemental sulphur, and Canadian producers as well as American are faced with a 20 per cent reduction.

Will Help Ease Shortage

The new $500,000 plant at Jumping Pound will initially produce 10,000 tons of elemental sulphur annually, Mr. Ash said. This will help considerably to alleviate the critical shortage in the present supply. Decision to build this sulphur plant followed negotiations with Powell River Co., who acted on behalf of a west coast pulp and paper group which has been seeking a Canadian source of sulphur for some months.

This is the second major economic contribution from this field in two years. Last year Shell Oil and Canadian Western Natural Gas Co. completed an agreement to pipe petroleum throughout Southern Alberta. The project included construction of a 12-in. transmission line from Jumping Pound field to Calgary and installation by Shell of petroleum gathering and processing facilities which are designed to permit expansion to several times the original volume.

Daily processing of these large volumes of natural petroleum makes available a constant source of sulphur. Work is to start immediately. Initially the plant will produce from 25 to 30 tons of elemental sulphur daily. Canadian and Northern United States newsprint is about 20 per cent sulphite pulp.

Shell Chemical Conference

Overseas Representatives Exchange Ideas

AT a five-day conference arranged by Chemical Industry Management, London, senior technical and commercial representatives met to exchange ideas and to discuss various aspects of Shell activities in the chemical field.

In addition to the United Kingdom, representatives came from some 23 countries in Europe, Africa, Middle East, and South America, and about 60 delegates were present daily with over 85 attending at one time or another during the conference.

The conference, which was held at Brighton, was inaugurated by Mr. W. F. Mitchell, head of Shell's Chemical Industry Management, who assessed the group's future rôle in the chemical industry. The first four days were devoted to a series of prepared papers followed by free discussions, and on the final day written questions submitted by delegates were answered and discussed. Among the subjects dealt with in the papers were: the organisation and purpose of chemical industry management; the development of markets for new products; and the marketing of established materials both in general terms and specifically in such countries as Canada, Denmark, Holland, Sweden, Switzerland, and the U.K.; the rôle of agricultural chemicals.

The concluding address was given by Mr. L. V. Steck, vice-president of Shell Chemical Corporation, who had contributed greatly to the conference during discussions with his lucid exposition of conditions in the United States. His final theme was the American chemical scene, a vast and still rapidly developing industry.

Portuguese Oil Refining

Plans have been made for the remodelling of Portugal's petroleum refining industry and it has been decided to extend till 1976 the concession of the Sociedade nonima Concessionaria da Refinacao Je Petroleos em Portugal (Sacor). A programme of technical renovation is to be undertaken by Sacor, which will necessitate an increase of 50 million escudos in its share capital.

New British Polystyrene Plant

Styrene Products Factory a Major Asset

A NEW British polystyrene plant is now in full-scale operation at Partington, near Manchester, England. The plant, owned and operated by Styrene Products, Ltd. (a company formed jointly by Petrochemicals, Ltd., and Erinoid, Ltd.) was designed, engineered and constructed by Petrocarbon, Ltd.

This plant is one of the most modern and efficient in the world. To ensure absolute purity of the product, all the buildings are sealed and air-conditioned; consistently high standards of operation are maintained by fully automatic control at every stage.

Until comparatively recently, the manufacture of polystyrene has been largely an American monopoly. The production from this British plant is, therefore, a major asset to the present and future of the British plastics industry.

The polystyrene—marketed under the 'Erinoid' trade name—is supplied in the form of moulding powder, sheet and rod.

As it is the lightest of all thermoplastics, polystyrene gives more mouldings per lb. of product than other materials. It is unaffected by moisture, it has a good resistance to heat, its electrical properties are of a high order, and it can be used in temperatures of extreme cold. The product has the ability to 'pipe' light—even through changes of direction—and this enhances its value for use in display signs and other transparent mouldings.

Colours range from crystal clear, through transparent, pastel and dense shades, to black. All the colours are bright, clear, and heat- and light-resisting.

The products can be cemented together, sawn, machined, turned, milled, painted or lacquered.

Styrene Products, Ltd., was formed in 1950. The plant covers an area of nearly 5 acres and production is at least 5,000 to 6,000 tons of polystyrene per annum.

The raw material for polystyrene is monomeric styrene; this will eventually be manufactured by Styrene Products, Ltd., from raw materials supplied from the adjacent petroleum chemicals plant of Petrochemicals, Ltd. In the meantime, imported monomer is being used.

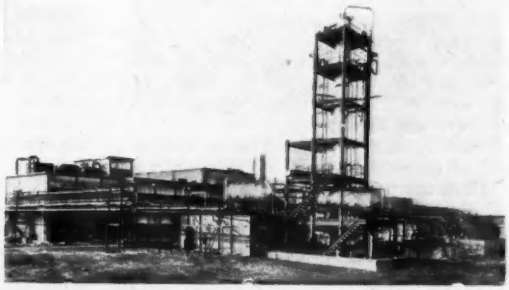
Erinoid, Ltd., the well-known and old-established firm of plastic manufacturers, are responsible for the marketing of the products both in the U.K. and overseas.

Technical research will be conducted by the staff of Petrocarbon, Ltd., and Erinoid, Ltd. The combined experience of these two companies, together with their comprehensive facilities, will ensure that Styrene Products remains at the forefront of technical development in the field of plastic materials.

Furthermore, the intimate association of Petrochemicals, Ltd., and Erinoid, Ltd., with the company, will enable the maximum benefit to be derived from their extensive operating and marketing experience; this will result in the maintenance of a highly efficient service to the plastics industry and the continued supply of top quality products.

The new British source of polystyrene should have far-reaching benefits for the injection moulding section of the plastics industry, and will enable it to enter more fully into an export field which, hitherto, has been limited.

At a Press conference held in the restaurant at 96 Piccadilly on Thursday, 10 May, the managing director, Mr. P. C. Chaumeton, said that polystyrene would some day largely replace other thermoplastics.



The polystyrene plant of Styrene Products, Ltd.

Proper Use of Plastics

Warning of Raw Material Shortages

WARNING against indiscriminate use of plastics to replace metals and other scarce materials during the present emergency, Dr. D. S. Frederick, chairman of the plastics committee of the American Manufacturing Chemists' Association, recently urged industrial designers and fabricators to give careful study to contemplated new applications of plastics to ensure they are properly used.

'Plastics possess characteristics which for many uses make them superior to any other material,' Dr. Frederick said, 'but they also have limitations that must be recognised. If manufacturers put plastics into products where they do not belong, simply because they may happen to be available, the public will lose confidence not only in the products but in a valuable new class of engineering materials.

'On the basis of their proved advantages plastics are finding an increasing number and variety of uses in their own right,' he continued. 'Producers and users alike must be alert to see that they are not exploited as inferior substitutes for other materials.'

As Critical as Steel

Dr. Frederick, who is vice-president of Rohm & Haas Company, Philadelphia, also cautioned against the belief that supplies of plastics are relatively plentiful. 'Some types,' he said, 'are just as critical as steel and aluminium, while others are fast approaching that point. Programmes for expanding output are being handicapped by shortages of basic raw materials such as benzene and chlorine, and these will require at least another year or two before supply can be brought up to demand.'

Military applications of plastics today include a much wider variety of items than during the last war, but the proportion of the industry's total output going into defence is still small.

'Plastics must be treated as a distinct class of engineering materials with characteristic properties, fabrication methods, and design requirements,' emphasised the doctor. 'For some applications they are clearly superior or equal to metal, glass, wood, and other conventional materials; for others they are unsatisfactory and should be ruled out.

'As with metals and wood, plastics are made up of a variety of basic types, and their individual characteristics differ widely. In addition there are numerous lesser variations of each type, so the job of selecting the proper plastic for a given application is one that requires a high degree of technical knowledge and experience. Failure to recognise this can result in heavy losses of money, time and materials.

'Recent advances are new plastic formulations that combine surface hardness with greater resistance to shock and chipping, which is important in the application to machine parts. Some of the newer materials also possess greatly improved dimensional stability, which permits fabricating to much closer tolerances than before. Significant improvements have been made in film and sheet forms of plastics, which have resulted in further inroads by these materials into fields previously served exclusively by textiles and leather.

'Generally speaking, it is lighter weight, ease of fabrication, resistance to corrosion, and in some cases lower cost, that account for the rapidly growing stature of plastics alongside other older engineering materials. How rapid this has been can be seen from increase in annual production figures of all types of plastics from 45 million lb. in 1928 to over 2,000 million lb. in 1950.

'This is better than a 50-fold increase in 22 years, but it still does not come up to current demand. Chemical companies are making every effort to bring in additional supplies of basic materials to meet the needs of plastics processors, but it seems at present as if supplies of most plastics will not be in balance with demand until sometime in 1952.'

Sulphuric Acid Output

Production of sulphuric acid in March rose to 136,200 tons compared with 118,900 tons in the previous month, according to the current issue of the Monthly Digest of Statistics (No. 64, April, HMSO, 2s. 6d.). Stocks of sulphur for sulphuric acid were 70,200 tons in February this year, which was 5,300 tons better than the previous month but 15,400 tons less than February, 1950. Weekly average production of steel ingots and castings fell from 326,000 tons in February to 318,000 tons in March.

Memorial Fund Awards

Metallurgist & Chemist Recognised

THE administrators of the Sir George Beilby Memorial Fund, representing the Institute of Metals, the Royal Institute of Chemistry and the Society of Chemical Industry, have decided to make two awards, each of one hundred guineas, from the fund for 1950. These awards have been made to: William Albert Baker, B.Sc. (Lond.), F.I.M., in recognition of his experimental contributions to knowledge of the factors determining the production of sound castings of non-ferrous metals and alloys; and Gordon Whittingham, M.A., Ph.D. (Cantab.), in recognition of his experimental contributions to knowledge of the combustion products of fuels containing sulphur and their effects on corrosion.

Awards from the fund are made to British investigators in science as a mark of appreciation of distinguished work, particularly in such fields as fuel economy, chemical engineering and metallurgy in which Sir George Beilby's special interests lay. In general, the awards are not applicable to the more senior investigators but are granted as an encouragement to relatively young men who have done independent work of exceptional merit over a period of years.

Led Team of Investigators

Mr. Baker joined the staff of the Assay Office, Royal Mint, London, as a student assistant and graduated in metallurgy at the University of London as an external student in 1934. Shortly afterwards he joined the British Non-Ferrous Metals Research Association as an investigator, where he was engaged mainly on problems connected with the melting and casting of non-ferrous metals. Most of his studies were devoted to the effects of volume changes and gas evolution in the solidification of metals and alloys, to the influence of alloy constitution and other metallurgical variables on the casting characteristics of the materials, and to the general principles to be observed in developing foundry techniques yielding serviceable castings. For several years he led a team of investigators in this and in the related field of welding non-ferrous metals, and more recently has supervised other researches in non-ferrous physical metallurgy.

Dr. Whittingham graduated from Cambridge in 1939 with 1st Class Honours in the Natural Science Tripos (Physical Chemistry). From 1939 to 1942 he worked in the Physical Chemistry Laboratory, Cambridge, on the frictional properties of dry and lubricated metal surfaces, with Dr. T. P. Hughes, and on the combustion of halogen derivations of methane, under the supervision of Professor R. G. W. Norrish.

In 1942 he joined the British Coal Utilisation Research Association in London as a member of a team engaged on an investigation into the corrosive nature of the products of combustion of solid fuels containing sulphur. During the next few years he carried out a study of the formation of sulphur trioxide during the pre-flame and flame combustion of carbon monoxide, hydrogen and hydrocarbon gases containing small amounts of sulphur dioxide. This work led to a new theory that sulphur trioxide could be formed in combustion processes as a result of a gas phase reaction between sulphur dioxide and oxygen atoms. His later work has included spectroscopic observations on flames containing sulphur compounds and on the luminescence of burning carbon, and an examination of the effects of fine smoke particles on combustion gases containing sulphur oxides. Dr. Whittingham is now the superintendent of the Combustion Department in the BCURA Laboratories at Leatherhead.

Enlarged BISRA Laboratories

The British Iron and Steel Research Association announce that they have acquired the whole of the light industrial premises at 140 Battersea Park Road, London, of which their physics, chemistry and plant engineering laboratories now occupy about one-quarter. This will make available some 43,000 sq. ft. of additional laboratory and office accommodation, until recently occupied by the research department of Powell Duffryn Research Laboratories, Ltd.

The Association's plant engineering division and chemistry department, including the corrosion and refractories sections, will move into the new accommodation as soon as necessary alterations have been sufficiently completed. Starting within the next two months the move will probably be completed in the autumn of this year. This in turn will make possible an expansion of the physics laboratories.

IN THE EDITOR'S POST

Outlook for Italian Sulphur

SIR,—The following personal comments on the article 'Outlook for Italian Sulphur' which appeared in your issue of 17 April, are offered as of possible use to the United Kingdom without ulterior motive for any attention you may desire.

Article Rather Naive

From a standpoint of close association with the Italian industry in a technical and industrial capacity the article is considered to be a rather naive one, while as a survey its completeness and accuracy are limited.

In a material sense it is an indisputable fact that sulphur exists in sufficient quantities in various parts of Italy to satisfy amply all outstanding demands of the U.K., and many other European markets, for a long time. It is also correct that no readily unsurmountable difficulties exist on a production level for its reasonably quick and economic provision for export.

The real cause of the present low availability and high cost is the effect of the policy and conditions governing its production and supply. These have developed in Italy in relation to this and other industries over many years to an almost integral stage in life and affairs, and solely by forces of an economic nature similar to those now being inculcated into U.K. life by the substitution of control for regulation.

Harmony Required

The stage is such that it overshadows all moral and spiritual considerations. It is one that requires the harmonising of facilities available on all levels for production and supply by material incentives in which by hard experience the Italian has become particularly adept.

Until the U.K. by less hypocritical action, having adopted the same course in life, will bend and accommodate efforts to suit the prevailing circumstances, the restrictions on this valuable and preferential source of supply seem likely to continue.

Any such efforts can hardly be achieved from an insular armchair point of view in the U.K. This important aspect is not even considered in the article but its better appreciation could be of great value to the U.K.

A summary of the article so far as the U.K. is concerned is that until a more realistic approach is made to foreign trade operations the outlook is practically nil.—Yours

C. H. DAVIES.

Naples, Italy.

Editor's note: The article to which Mr. Davies takes exception was written by one of Italy's best known chemical engineers —a consultant with an international reputation, life-long experience of the Italian chemical industry and very high academic qualifications.

New Hercules Powder Works

IN the course of a ceremony held in April, Charles A. Higgins, president of Hercules Powder Company Incorporated, of Wilmington, Delaware, U.S.A., cut the first sod of a factory building site at Church Menorway, Erith, and thus formally initiated the construction of a new works. Mr. Higgins was introduced by Mr. C. H. B. Rutteman, managing director of Hercules Powder Company, Ltd., a British subsidiary wholly owned by the American Company.

Since beginning operations in 1924, Mr. Rutteman said, the Paper Makers' Chemical Plant, owned by Hercules Powder Co., Ltd., at Cory's Wharf, Edith, has steadily increased its output. The time has now come when a larger unit is required to satisfy industrial demands.

The new factory will, of course, be modern in every way. Improvements in processes and products will be made, and full advantage will be taken of the latest developments in American research and process study.

The area to be developed covers about 10 acres and is connected by a rail siding to the Southern Region railway system and to a riverside wharf. Concrete approach roads are planned to accommodate incoming and outgoing traffic, so that the products can be despatched by rail tank, road tank, or in drums.

Among the products to be offered are Superior and Samson rosin size, already well established in the British market. Paracol (wax emulsion), Dresinols, Rosin Emulsions and Defoamers. The company hopes to be in full production within 12 months and to pass on to the industry the full benefit of knowledge acquired during many years of operation in the States and in England, and backed by their own research.

The Chemist's Bookshelf

MODERN CHEMICAL PROCESSES. By the editors of 'Industrial and Engineering Chemistry.' Reinhold Publishing Company, New York, and Chapman & Hall, London, 1950. Pp. 222. Price 32s.

This book is in the form of a series of 23 articles dealing with recently developed American chemical processes which are at the present day being operated on a production scale. The material has been edited by the editors of *Industrial and Engineering Chemistry* and a number of the staff of that journal have collaborated in the writing of the articles. The book is intended to be the first of a regular series, the aim being to publish one volume containing information on twenty-four processes every two years, thus building up an encyclopaedia of chemical technology. The production of the present volume is excellent; it has been well printed upon good quality paper, is lavishly illustrated and adequately indexed. The articles are said to be comprehensive but less than ten pages has been devoted to each subject and in this space it has only been possible to give an outline of each process. The information given applies directly only to American plants and methods but there is a deplorable lack of published material upon chemical technology and this book will provide a fruitful source of ideas to the plant chemist and chemical engineer. The processes covered include the production of the heavy basic chemicals, the vegetable oil industry, synthetic resins and rubbers, the paint and fine chemical industries, and the manufacture of soap.—J.R.M.

THE CHEMICAL ANALYSIS OF WATERS, BOILER AND FEED-WATERS, SEWAGE, AND EFFLUENTS. Denis Dickinson. Second Edition. London: Blackie & Son, Ltd. Pp. 144. 6s. 6d. net.

The second edition of this little book is but slightly larger than the original, the author having replaced certain methods by others which he himself considers to be improvements on the earlier methods. It should prove of value both to water analysts and in particular to certain industrial analysts to whom water analysis is a small but essential part of the daily routine.

The reviewer feels that the electrometric method described in the chapter on alkalinity and acidity, while inexpensive, is somewhat obsolete and could be replaced with advantage by a more modern set-up. Again, in the determination of sodium and potassium, the method recommended involves the removal of all other metals, the alkali metals then being converted to the mixed chlorides. Potassium is determined as chloroplatinate and the sodium by difference. This time-consuming procedure could be considerably improved upon by determining the potassium in one aliquot as the cobaltinitrite—sufficiently accurate results would be obtained in this way—and the sodium in another aliquot by precipitation as sodium zinc uranyl acetate.

These are minor points, however, and do not detract in any way from the value of a book in which the author has managed to incorporate sufficient material to give an excellent guide to a really wide subject.

The book should also prove useful to analysts in the teaching profession who may wish to introduce water analysis into their courses.—A.J.N.

ZIRCONIUM is apt to be regarded as a newcomer to the field of metallurgy, although produced over 100 years ago. It is more accurate to say that ductile zirconium is new, as the earlier products were not capable of being worked. Now being produced for the first time in this country on a commercial scale by Murex, Ltd., zirconium has many valuable properties and is most suitable for chemical plant where corrosion resistance is required. Production of zirconium and its varied applications are described by Dr. G. L. Miller in the latest issue of the 'Murex Review' (No. 8, 1951).

• OVERSEAS •

Ardal Aluminium Plant

The Norwegian Government aluminium plant Ardal Verk recently published its accounts and annual report for 1950. The report shows that 20,077 tons of aluminium were produced last year, and that production is now running at the rate of 24,000 tons a year. Of last year's output, 6,536 tons were transferred to Aluminium Union, Ltd., of Canada, as payment for raw material (oxide) received. In addition 12,381 tons were exported to 13 countries, including 2,701 tons against dollar payment. The demand has been heavy and prices rising.

U.S. Sulphur Exports

The U.S. Department of Commerce's Office of International Trade has announced that it will licence 230,000 long tons of crude sulphur, and 7,500 tons of refined and processed sulphur for export in the second quarter of this year. The department noted that the present quota, which brings to 480,000 long tons the total amount of crude sulphur available for exports during the first half of the year, is 'essential to meet the bare minimum needs of friendly importing nations.' The 50,000 tons of sulphur recently made available to 'hardship' nations will be deducted from the second quarter shipment allocations.

U.S. Ethanolamine Production

Increased production of ethanolamine will be undertaken by the Dow Chemical Company and may be an important factor in relieving the current shortage of natural sulphur, according to C. B. Branch, manager of Dow's technical service and development division. The chemical is currently being used by several Dow customers to remove sulphur from natural gas, and in some instances this sulphur is being converted to sulphuric acid.

Sulphur is present in natural gas as hydrogen sulphide. The latter chemical is removed by washing the gas with an ethanolamine solution. The hydrogen sulphide is then removed by heating the solution which can be reused for gas purification. Elemental sulphur is obtained by burning the recovered hydrogen sulphide. The same recovery method is used for carbon dioxide.

Ecuador Not Discouraged

Endeavours are being made for developing sulphur mines in Ecuador. Some doubt exists regarding the potentialities of these deposits, but probably there are mines which can be worked to advantage at the high prices now ruling for sulphur. However, it is not the official intention to export this product but to build factories for making sulphuric acid, caustic soda and rayon.

Canadian Sulphur Hopes

The Canadian Federal Government has announced that a huge deposit of bituminous sands in the northern part of the dominion is being tested as a possible new major source of sulphur. It is understood that current laboratory research work has indicated that the sands, located in Alberta, have a sulphur content averaging about 5 per cent and that this might lead to a commercial development. Canada needs sulphur particularly for her paper-making industry, and to conserve dwindling supplies she has placed a ban on all exports of sulphur.

New Cement Plants

New cement factories, with a combined annual capacity of 300,000 tons, are planned for the States of Rio Grande do Sul and Rio de Janeiro (Volta Redonda). Existing cement plant have been enlarging their productive capacity, and it is estimated that the resulting overall increase in output, which may exceed 400,000 tons, will make Brazil practically self-sufficient as regards cement supplies. The increase corresponds approximately to imports for 1949.

Trichlorobenzene in Production

Trichlorobenzene, a clear, colourless liquid, predominating in the 1,2,4 isomer, and containing small amounts of other isomers and high-boiling materials, is now being produced in pilot plant amounts by the Pennsylvania Salt Manufacturing Company, Philadelphia, Pa. The chemical compound is a major ingredient in compounded transformer oils and is claimed to be an excellent solvent for oils and fats, waxes, certain resins and oil soluble dyes. It is also used as a dye intermediate, a heat transfer medium, a lubricant, and as a toxicant in the control of termites.

· PERSONAL ·

Co-inventor of the Geiger radioactivity counter, and an authority on industrial electromes, DR. WALTER MULLER, is now in Melbourne, Australia, where he will be attached to the Ministry of National Development. Before World War II Dr. Muller conducted extensive research into cosmic rays and atomic problems as well as into radioactivity. In conjunction with a medical research scientist, he has discovered a means by which certain radioactive minerals can be maintained in, and also steered through, various organs of the human body.

MR. E. S. PEARSE, A.F.R.Ae.S., A.M.I.Prod.E., has been appointed works manager of Quickfit and Quartz, Ltd., manufacturers of laboratory, chemical and industrial glassware, of Stone, Staffs.

Mr. Pearse's appointment coincides with the reorganisation of executive positions in the company in which MR. B. H. TURPIN becomes technical and sales director; MR. E. L. HARRISON commercial sales manager; and MR. D. CURTIS development manager. Mr. Pearse, who is 44, formerly worked in the production, planning and progress departments of Vickers-Armstrongs, Ltd., aircraft designers and constructors, of Weybridge, ending his service as senior subcontracts manager. Subsequently he was group production manager of the Hunting Aviation Management, Ltd., Luton Airport; production manager of the Wembley television factory of Scophony-Baird, Ltd.; and production manager of Autotrope, Ltd., instrument and commercial projects designers and aircraft component manufacturers, of Salisbury. In 1945 Mr. Pearse visited India at the request of the High Commissioner to advise on production of metal aircraft.

MR. A. J. THOMPSON has resigned on medical advice as chairman and director of R. W. Greeff & Co. Ltd., and Greeff Chemicals Holdings Ltd., after 44 years' continuous service. He will continue to be associated with the business in a consulting capacity. Joining R. W. Greeff & Company as a manager in 1907, having previously been with Burroughs Wellcome & Co., he was a director of R. W. Greeff & Co. Ltd., from its formation in 1920, managing director from 1936, chairman from 1942, and played a great part in the continued expansion and success of the business. Mr. Thompson and Mrs. Thompson were entertained at a complimentary luncheon on Tuesday, 8 May, at which Mr. Bayliss Smith, F.C.A., on behalf of the directors, presented him with a Royal Doulton dinner service and cut crystal tableware as a personal tribute of the esteem and affection of all those who had been associated with him.

Chemical Restrictions in Canada

RESTRICTIONS on most basic chemicals are having a widespread effect on spot buyers in Canada, reports the Toronto Purchasing Agents' Association. In the Dominion, the most notable of these items are phosphates and acids derived from sulphur; chemicals derived from ethylene, coal, and some petroleum base chemicals. Some European materials will be available with the opening of navigation. Phosphates can be procured at a price considerably higher than the Canadian market. In most cases, European chemicals are not available direct, but only through brokers.

The supply position on caustic soda and chlorine, in Canada, has improved slightly over the past month while both items remain in very short supply in the U.S.A. Supplies of coal chemicals such as benzol, toluol and xylol, in the Dominion, still exceed the demand and these items are allocated by the producer based on past purchases. In America, benzol and toluol have been severely cut by defence orders with the result that the production has been hampered on a large number of items. Certain restrictions upon the export of Canadian benzol may tend to improve the supply picture. Most solvents and alcohols remain in good supply. Supplies of formaldehydes and methanol appear adequate for the time being. The tallow market remains firm with a heavy demand from soap producers.

Butyl alcohol and butyl acetate supplies which have been severely cut in the U.S.A. by defence needs, appear to have improved.

HOME

Imports of Sulphur

Sulphur was the most important item on a list of Marshall aid commodities due to arrive in British ports last week. The expected quantity of 9,400 tons brings the total amount of sulphur, supplied under the Marshall Plan from the U.S.A. to Britain in the last seven months, up to 216,750 tons, valued at nearly £1.75 million. Other shipments scheduled for last week included zinc (550 tons), lead (300 tons), copper (205 tons), steel (102 tons), and carbon black (506 tons).

Work Commences

Work has begun recently on the new £1,000,000 chemical plant at Grangemouth for Forth Chemicals, Ltd., thus carrying a stage further the programme of expansion of the Grangemouth distillery. The new plant will manufacture a wide range of petroleum chemicals from the raw materials derived from the work now going into full gear at the Grangemouth refinery. Work will be pushed forward as quickly as possible in order to ensure the maximum national advantage from the development, whose products will replace some at present derived from import sources.

Office Closed

The Atomic Scientists' Association announces that its office at 7 Victoria Street, S.W.1, has been closed. All correspondence should in future be addressed:—c/o Professor Rotblat, Physics Department, Medical College of St. Bartholomew's Hospital, Charterhouse Square, London, E.C.1.

Lightning Quick Service

During the recent BIF, Mr. H. E. Gray, of the Canadian Department of Agriculture, asked Mr. Edward Gurr, managing director of Edward Gurr, Ltd., if he could help solve the problem of detecting insect pests in flour samples. Mr. Gurr worked in the portable laboratory on the firm's stand at Olympia between seeing representatives from some 30 countries who were interested in his firm's biological stains and reagents, and within a day or two announced that he had a solution and was writing to Mr. Gray. Mr. Gurr is following this up by sending the Canadian official samples of the fluorescent dye he has produced and which he feels sure will make differential staining of insect particles child's play.

Imported Sulphuric Acid

Sir Hartley Shawcross, President of the Board of Trade, stated in the House of Commons last week that the question of relieving imported sulphuric acid from the charge of 10 per cent general *ad valorem* duty was under consideration.

Textile Institute Annual Conference

When the official opening ceremony of the Textile Institute's annual conference on 'Textiles: Their Past, Present and Future' takes place at Brighton on Tuesday, 22 May, greetings from the American Panel of the Institute and from the American Association of Textile Chemists and Colourists will be conveyed to the conference.

Pyrites Exports

In the Commons last week, Mr. Edward Wakefield, Member for Derbyshire West, asked the President of the Board of Trade what quantity of spent pyrites had been exported to Germany and other countries, respectively, during the last 12 months.

Mr. Rhodes, the Parliamentary Secretary to the Board of Trade, replied that exports of spent pyrites are not separately recorded in the official trade statistics of the United Kingdom. The only export of pyrites cinders was 21,400 tons in 1950 to Germany.

Mr. Cyril Osborne, Member for Lincoln, South, asked the President of the Board of Trade in Parliament if he was now in a position to say whether the 19,000 extra tons of sulphur would be received in the second quarter of this year; and what were the prospects of receiving the same amount by which the first quarter's supply fell short of our minimum requirements.

Mr. Rhodes replied on behalf of the Board of Trade, saying that the allocations of sulphur for the first half of this year had now been made by the United States Government and totalled 195,465 tons. This tonnage was made up of 81,465 for the first quarter, the supplementary allotment of 19,000 and 95,000 for the second quarter.

Publications & Announcements

THE Dunlop Rubber Company have issued a handy and short list of safety precautions to be observed in the technical departments of their company. This accompanies an exhibition on the same subject at the Dunlop Research Centre from 23 April to 20 May. The booklet is divided into four sections—general safety, fire and first aid, laboratory practice, and electrical procedure in laboratories. The recommendations are practical, and the only criticism is that where dangerous materials and vapours are dealt with, the booklet confines itself merely to mentioning that they *are* dangerous, without telling anyone what to do about most of them. The rest of the book, however, is admirable.

* * *

A TRUCK and lifter combined, by means of which one man can easily raise barrels or steel drums up to 60 gallons capacity (up to 8 cwt.) is described in a leaflet issued by the A.P. Manufacturing Co., Ltd. Easy lifting is ensured by the scientifically balanced design and the rolling motion on the quadrant. The barrel is held safely in position by a band. The Donald one-man barrel truck was on view at the Castle Bromwich section of the British Industries Fair.

* * *

FEATURED on the stand of Newton, Chambers & Co., Ltd., at the Olympia section of the B.I.F. was their new washing cream, Zalpon. This is a clear olive green blend of the highest quality concentrated soap and the finest toilet detergents and a 20 oz. bottle is said to give 2,240 washes as ¼ gram is sufficient for ordinary purposes. The use of liquid soap in public or factory wash-rooms is said to be at least six times more expensive, and the use of bar toilet soap at least 2½ times more costly.

Zalpon is smooth and creamy, pleasantly perfumed and as it is neither solid nor liquid, but a thick cream, it can be delivered in exact quantities. The Zalpon dispenser which Newton Chambers are marketing with the cream can be pre-set by the owner to regulate the amount delivered and is the essence of simplicity. Empty jars can be replaced in a few moments and the cream cannot be pilfered.

TWO latest additions to the Penguin series are 'A Dictionary of Science,' compiled by E. B. Uvarov and D. R. Chapman, and 'Science News 20,' edited by A. W. Haslett. It is a formidable task nowadays to compile a dictionary of anything, let alone science, but the authors of this dictionary have done surprisingly well in giving brief and lucid explanations, where explanations are possible, of most of the terms used in science today. This could be of interest not only to the layman who is confused by the welter of technical terms flung at him from day to day in totally differing contexts, but also, say, to the expert in meteorology who wants to find out what the latest perpetration in nuclear physics means.

The second booklet, 'Science News' is a thoroughly readable little book containing highly specialised material written by people who know what they are talking about. The present issue deals with such varied articles as the shape of inorganic molecules, control of insect populations, the science of lubricating greases, the origin of language, advances in anaesthesia, and the colours of the stars. Such a wide field can be child's play to nobody, and this book should make fascinating reading to anyone from professor to engine-driver provided he has a scientific turn of mind.

* * *

THE Cambridge Instrument Company Ltd. published the first of a series of monographs whose purpose, they say, is to place on record the indebtedness of the instrument makers, and indeed of the whole world, to prominent men associated with the company who have developed progressive scientific instruments. This monograph, no: 3, deals with the thermal conductivity method of gas analysis, due principally to Dr. G. A. Shakespear, which has proved valuable in a wide field of application.

* * *

NOW available from Richard Sutcliffe Ltd., of Wakefield, are a number of new industrial conveying pamphlets giving technical details and illustrations of mechanised means of conveyance in a wide variety of

industrial conditions, such as at quarries, the chemical, coal, coke and ore handling industries. The belt conveyor, as these pamphlets show, is a versatile servant.

* * *

THE British Chemical Plant Manufacturers' Association has recently published its 1951 handbook on chemical plant. This book is a complete guide to all plant manufactured in Great Britain. Besides a classified index of products and services, this work has an illustrated section showing types of plant dealt with. As everyone who has seen previous issues would expect, the volume is well turned out, with a good binding. These directories have proved of great value to users of chemical plant in the past and there is every reason to believe that the 1951 handbook will be of even greater usefulness than its predecessors. As the chairman points out in his forward, the new volume ' not only indicates the growth in range and strength of the Association during recent years, but reflects the wide scope and increasing diversity of the British Chemical Plant industry.'

* * *

FLOOR finishes probably give rise to a greater diversity of problems in industrial buildings than any other part of their construction. Safety, resistance to wear and chemical attack are three obvious requirements, but other important factors are 'tread' or 'feel', noise, and the effect of appearance. All these problems are covered in 'Floor Finishes for Industrial Buildings,' a booklet just published by the Department of Scientific and Industrial Research (National Building Studies Special Report, No. 11, HMSO, 1s. 6d.). All types of industrial floor finishes are listed and their performance for a wide variety of uses given. Much of the information has not been published before, and the booklet should be of particular interest to chemical works.

* * *

CRUSHING equipment of all kinds is described in the latest publication of British Jeffrey-Diamond, Ltd., which has machines for breaking, pulverising and grinding friable and semi-friable materials to suit product requirements from 8 in. cube down to minus 300 B.S. mesh. The booklet, which is illustrated, includes single roll breakers, flextooth and rigid hammer crushers, and swing hammer pulverisers for reducing bone, chemicals, glass, limestone, oxides and similar materials. A number of the machines can also be adapted for reducing fibrous materials.

* * *

THE proceedings of the Chemical Engineering Group of the Society of Chemical Industry for 1949 have been recently brought out. Besides the society's annual report the booklet contains articles on the granulation of compound fertilisers, technical education, the beet sugar industry and other subjects. At the beginning is a transcription of a most interesting speech by Colonel The Rt. Hon. Walter Elliot, M.C., F.R.C.P., F.R.S., M.P., at the thirtieth annual dinner.

* * *

A MODIFICATION is announced by E. Boydell & Co., Ltd., Manchester, to their 4½ cu. yd. Muir-Hill 14B Dumper. Springs may now be fitted to this machine, at option, thereby improving the performance and legalising the machine for highway use. The springs, of the slipper box pattern, are transverse mounted at the front and semi-elliptic at the rear.

The front, transverse spring, is mounted on the steering axle by a centre pin and bracket and secured by inverted 'U' bolt clamps. The radius rod is fitted with a semi-universal joint at its connection with the centre cross-member to accommodate spring deflection.

The rear springs, of the semi-elliptic type, are secured above the rear axle by clamping plates and bolts, and are anchored in the forward slipper box by a dowel pin. The slipper boxes are grease packed.

* * *

THE National Smoke Abatement Society has just published their 1951 Year Book, comprising a considerably extended version of their former annual report. This booklet gives an account of the society's activities over the last year and information with regard to the law relating to smoke pollution and alkali works, etc. It also contains an instructive article on research carried out by the DSIR on problems of atmospheric pollution caused by the burning of coal.

Next Week's Events

MONDAY 21 MAY

The Chemical Society

Dublin: Trinity College, 7.45 p.m. Prof. R. B. Woodward: 'Some Recent Advances in the Chemistry of Natural Products.'

Electrodepositors' Technical Society

London: The Northampton Polytechnic, St. John Street, E.C.1, 6 p.m. Spring Meeting—Election of Council. Paper presented by S. C. Britton and R. M. Angles: 'Corrosion Resistance of Electrodeposited Tin-Nickel Alloy.'

TUESDAY 22 MAY

Society of Public Analysts

London: Institute of Physics, 47 Belgrave Square, S.W.1, 4 p.m. Radiochemistry meeting—four papers including 'Radioactive Tracer-paper Chromatography Techniques' and 'The Determination of Submicrogram Quantities of Arsenic by Radioactivation.'

Incorporated Plant Engineers

Buxton: The Palace Hotel. Three-day conference.

Society of Visiting Scientists

London: 5 Old Burlington Street, W.1, 7.30 p.m. Discussion Meeting: 'The Biological and Chemical Control of Insect Pests.'

WEDNESDAY 23 MAY

The Chemical Council

London: The Royal Institution, Albemarle Street, W.1, 3 p.m. Second in the Festival series 'Chemistry in the Service of Man.' Sir Jack Drummond: 'Chemistry and the Food We Eat.'

Society of Chemical Industry

London: Waldorf Hotel, W.C.2, 6.30 p.m. 32nd Annual General Meeting and Dinner of the Chemical Engineering Group.

FRIDAY 25 MAY

The Chemical Society

Dublin: Trinity College, 8 p.m. Prof. M. G. Evans: 'Electron Transfer Reactions.' (Jointly with Werner Chemical Society.)

Institution of Electronics

Manchester: Reynolds Hall, College of Technology, 7 p.m. L. Atkinson: 'High Voltage Oscillograph for Photography of Transients.'

Market Reports

LONDON.—The influence of the Whitsun holiday has made for less active trading conditions on the industrial chemicals market, but the volume of inquiry for new business has been greater than is usual for the period. The market generally remains very firm, with supplies of many items short of meeting the demand. The calls for potash continue steady and there is considerable pressure for delivery of bleaching powder and white powdered arsenic. The solvents generally are in strong request as also are the lead oxides. The position of most of the coal tar products remains unaltered with production already sold for some months ahead. A substantial export inquiry is in circulation for cresylic acid, naphthalene and phenol, but so far as the last two items are concerned none can be released for export.

MANCHESTER.—As the result entirely of holiday conditions trading on the Manchester chemical market during the past week has been quieter than usual. In many instances because of consuming works closing down for varying periods contract deliveries have been interfered with and less new business has been placed. An early return to active trading conditions is looked for in all sections of the trade. Meanwhile, prices keep very firm.

GLASGOW.—The past week has been one of steady demand from all branches of the consuming trade. Prices have remained steady and some trades have found supplies, although not free, considerably easier. Demand from the export market has continued to be brisk and a steady all-round trade is being done.

CLASSIFIED ADVERTISEMENTS

SITUATIONS VACANT

A CHEMICAL PLANT MANAGER is required by Laporte Chemicals Limited at their Luton Works. Applicants should have an Honours Degree in Chemistry or Chemical Engineering or the equivalent. Some industrial experience, though not essential, would be of advantage. The work involved is in a rapidly developing field of organic peroxide manufacture and the wide range of the Company's products offers considerable scope for the right man. A pension scheme is in operation. The salary offered will be in accordance with qualifications and experience. Apply to **Works Manager, Laporte Chemical Limited, Kingsway, Luton, Beds.**, giving details of age, education, qualifications and experience.

RESEARCH CHEMIST (INORGANIC) is required by a progressive Chemical Manufacturing Company in South West Lancashire. B.Sc., or A.R.I.C. essential, but applications are also invited from University students who expect to qualify this summer. The position is permanent and is covered by a superannuation scheme. Applications should be marked "Research Chemist" and contain particulars of age, qualifications and experience. Box No. C.A.3015, THE CHEMICAL AGE, 154 Fleet Street, London, E.C.4.

THE Civil Service Commissioners invite applications for permanent appointments as **SENIOR SCIENTIFIC OFFICER** and **SCIENTIFIC OFFICER** to be filled by competitive interview during 1951. Interviews began in January and will continue throughout the year, but a closing date for the receipt of applications earlier than December, 1951 may eventually be announced. Successful candidates may be appointed immediately. The posts are in various Government Departments and cover a wide range of Scientific research and development in most of the major fields of fundamental and applied science. Candidates must have obtained a university degree with first or second class honours in a scientific subject (including engineering) or in Mathematics, or an equivalent qualification, or possess high professional attainments. Candidates for Senior Scientific Officer posts must in addition have had at least three years' post-graduate or other approved experience. Candidates for Scientific Officer posts taking their degrees in 1951 may be admitted to compete before the result of their degree examination is known.

Age limits: For Senior Scientific Officers, at least 26 and under 31 on 1st August, 1951; for Scientific Officers, at least 21 and under 28 (or under 31 for established civil servants of the Experimental Officer class) on 1st, August, 1951. Salary scales: For men in London, Senior Scientific Officers, £700 by 25—£900; Scientific Officers £400 by 25—£650. Rates for women are somewhat lower.

Further particulars from the **Civil Service Commission, Scientific Branch, Trinidad House, Old Burlington Street, London, W.1.**, quoting No. 3399.
10226/250/MLB

WORKING NOTICE

THE Proprietors of Patent No. 601,290 for **"CELLULOSE BLEACHING"** desire to secure commercial exploitation by Licence in the United Kingdom. Replies to **HASELTINE LAKE & CO., 28 Southampton Buildings, Chancery Lane, London, W.C.2.**

FOR SALE

600

CHEMICAL PLANT

SENIOR 45 in. **PACKING M/C.**, for powder materials Jackson & Crockatt, motorized 400/3/50. Operation on special 'receding' worm principle. Will pack large variety of jars, bottles, tins or cartons.

JAR AND BOTTLE CAPPER by Gravill. Cap. approx. 36 per min. with adjustment for various sizes. Motorized 220/240/1/50, through reduction gear. Unit mounted on C.I. stand with castor wheels.

LABELLING M/C by Dawson. Cap. 30 labels per min. singles. Motorized 220V. D.C., foot pedal operated (continuous or single op.) Fitted gumming rolls and various bottle rests.

BOTTLE RINSING M/C by Thomas & Hill. Chain conveyor type, 12 ft. centres double row bottle fixtures 132 head. Rotary jet rinsing. Cap. 150 dozen half or pint bottles per hour. Motorized 400/3/50.

LABELLING M/C by Rawsons, for pint or 16 oz. size flat or square. Cap. 24-30 per min. Numbering device. Motorized 400/3/50. Unit mounted on rubber tyred wheels.

6 ELECTRIC MAGNETIC SEPARATORS by H. G. Richardson. Reco type No. D.83 . 180V. 1 amp.

Carton **FILLING, PACKING, WRAPPING AND LABELLING M/C** by Societe Industrielle Suisse, adjustable for cartons from 73 mm. sq. × 38 mm. to 65.6 mm. sq. × 38 mm. Motorized 400/3/50. Complete with label attachments and heat sealing device. Conveyor feed approx. 55 per min.

GEORGE COHEN SONS & CO., LTD., SUNBEAM ROAD, LONDON, N.W.10.
Tel.: Elgar 7222 and
STANNINGLEY NR. LEEDS,
Tel.: Pudsey 2241.

CHARCOAL, ANIMAL and VEGETABLE, horticultural, burning, filtering, disinfecting, medicinal, insulating; also lumps ground and granulated; established 1830; contractors to H.M. Government.—THOS. HILL-JONES, LTD., "Invicta" Mills, Bow Common Lane, London, E. Telegrams, "Hilljones, Bochurch, London," Telephone 3285 East.

PHONE 98 STAINES

JACKETED BALL MILL, 33 in. by 34 in. diam., by "Houchin."

Spencer Hopwood Oil fired **BOILER**, 1,380 lb. evap., 100 lb. w.p.

Lard **COOLING ROLLS** or **FILM DRYERS**, 9 ft. by 4 ft. diam.

Twin Gunmetal "Z" blade Jac. Vacuum brass lined **TIPPING MIXER**, 28 in. by 26 in. by 20 in. deep.

Unused Brass Shell **CONDENSERS**, 3 ft. 6 in. by 5 in. diam., 325—¾ in. diam. copper tubes.

HARRY H. GARDAM & CO. LTD., STAINES

MORTON, SON & WARD, LIMITED
—OFFER—

4-IN. cast iron 4-hole **FLANGED PIPING**, approx. 500 ft. in 9 ft. lengths. In excellent condition.

6-in. **STEEL PIPING**, approx. 400 ft. in 20 ft. lengths, screwed and flanged, also bends. As new.

MORTON, SON & WARD, LIMITED, WALK MILL, DOBCROSS, NR. OLDHAM, Lancs.
'Phone: Saddleworth 437

FOR SALE

VARIOUS MIXERS FOR SALE

BAND CONVEYOR, 50 ft. long 40 in. wide, steel frame motorised, for boxes, cases, bags, etc.

A FILTER PRESS, 31½ in. square, fitted with 42 C.I plates, centre fed.

1½, 2½ and 3½ size belt-driven DISINTEGRATORS by Christy & Norris or Harrison Carter.

Size No. 3 Junior Hammamac HAMMER MILL with fan and cyclone, also No. 1 size Miracle **GRINDING MILLS** and one size 3W Miracle **GRINDING MILL.**

Robinson 3-sheet No. 1 size **CENTRIFUGAL DRESSING MACHINE** for dry powders, etc.

Gardner Size "G" **RAPID SIFTER** and **MIXER,** belt and gear driven.

Two Gardner **RAPID MIXERS** only, 40 in. long, 14 in. wide, one provided with small separate A.C. Motor.

Four **ROTARY BOWL MIXERS,** 5 ft. diam., cast iron built, inclined agitators, by Baker Perkins.

One Broadbent under-driven **HYDRO EXTRACTOR** self-balancing type, with self-contained A.C motor.

Two **FILTER PRESSES,** fitted recessed C.I. plates, 40 in square, 2½ in. thick, centre fed, to make 11 cakes per Press.

One Lilleshall **FILTER PRESS,** fitted 18 C.I. plates, 36 in square, and 19 C.I. frames, with side inlet, side enclosed delivery and usual fittings.

Kek **GRINDING MILL,** square pin type, with grinding discs 13 in. diam., including circular delivery bin with single outlet.

Large unjacketed **WERNER MIXER,** belt and gear driven, hand tipping, double "Z" arms, pans 53 in. by 45 in. by 36 in. deep.

No. 200 One nearly new **WERNER PFLEIDERER JACKETED MIXER OR INCOPORATOR.** Low type, with C.I. built mixing chamber, 28 in. by 29 in. by 27 in. deep, with double "U"-shaped bottom which is jacketed, and double fish-tail or fin-type agitators geared together at one side, with belt-driven friction pulleys, 34 in. diam. by 5 in. face, with hand-wheel operation and hand-operated screw tilting gear. Machine fitted with machine-cut gears covers, gear guard, cast-iron baseplate, and measuring overall approximately 7 ft. by 6 ft. by 4 ft. high to the to of the tipping screw

No. 209 One **HORIZONTAL 'U"-SHAPED MIXER,** steel built, riveted, measuring about 8 ft. 3 in. long by 3 ft. wide by 3 ft. 3 in. deep, with horizontal shaft, fitted with bolted-on mixing arms about 18 in. long by 4 in. wide, with intermediate breakers, and driven at one end by a pair of spur gears, with countershaft, fast and loose belt pulleys, outer bearing and plug cock type outlet at the opposite end, mounted on two cradles fitted to two R.S.J. running from end to end.

Further details and prices upon application

Write RICHARD SIZER LIMITED, ENGINEERS CUBER WORKS, HULL

MONEL METAL LINED STEAM JACKETED PAN, 75 gallons capacity, with fittings.
HAROLD POTTER & COMPANY, LTD., CANAL STREET, NOTTINGHAM,
Tel. 44620.

FOR SALE

MORTON, SON & WARD, LIMITED
—OFFER—
HYDRO EXTRACTORS

72-in. by **BROADBENT,** all-electric, under driven.
TWO 48-in. by **BROADBENT,** all-electric, under driven, direct coupled to electric motor, steel galvanised baskets, 3-point suspension.
TWO 42-in. by **WATSON LAIDLAW,** all-electric, under driven through vee ropes from flange-mounted vertical spindle motor, copper tinned baskets, 3-point suspension.
TWO 36-in. by **BROADBENT,** all-electric, under driven through vee ropes from flange mounted vertical spindle motor, steel baskets.
ONE 30-in. by **BROADBENT** as above.
HOPKINSON CENTRIFUGES, types 3 and 4 with built-in motors.
ALL machines suitable for 400/3/50 supply and complete with cabinet starters.
A large selection of **MIXERS** and **JACKETED BOILING PANS** in stock.
Your specific plant enquiries solicited.
MORTON, SON & WARD, LIMITED,
WALK MILL,
DOBCROSS, NR. OLDHAM,
Lancs.
'Phone : Saddleworth 437.

NORTHEY-BOYCE Twin Rotary Dry **VACUUM PUMP** 180 c.f.m. or 364 c.f.m. series or parallel running mounted on Bedplate.
Several Lacey-Hulbert **VACUUM PUMPS** from size 0.
Vertical Egg-Ended **PRESSURE VESSELS** 5 ft. by 12 ft. 6 in. 100 lbs p.s.i. ¼ in. plate.
Unused Baird & Tatlock 8 gallon **REFRACTIONATING VACUUM STILL.**
Heavy Copper Horizontal **VACUUM MIXERS,** cylindrical, from 80 gallons to 500 gallons, with motor drives.
New Stainless Steel **VESSELS** in stock 25/250 gallons.
REED BROTHERS (ENGINEERING) LTD.,
REPLANT WORKS, CUBA STREET,
MILLWALL, E.14.
'Phone EAST 4081.

3 M.S. Welded Jacketed **PANS,** 24 in. diam by 26 in. deep, 1½ in. bottom outlet, mounted on angle legs. Tested 100 lb. hydraulic pressure.
THOMPSON & SON (MILLWALL) LIMITED
CUBA STREET, LONDON E.14.
Tel.: East 1844

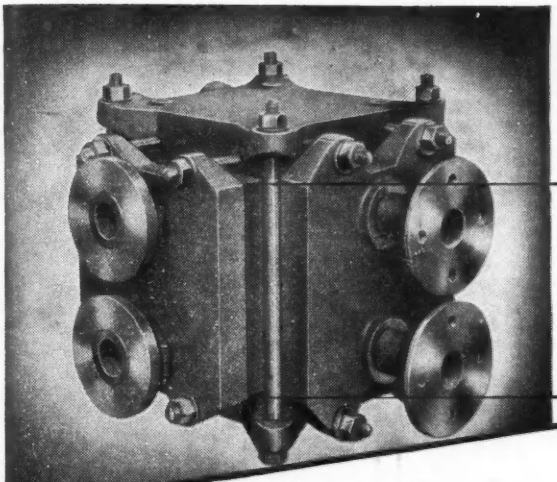
8 COPPER-jacketed **MELTING PANS,** 18 in. diam. by 12 in. deep, fitted covers. mounted in M.S. frames 25 in by 25 in. by 44 in. high, with flanged fittings, valves and steam traps. As new.
THOMPSON & SON (MILLWALL) LIMITED
CUBA STREET, LONDON, E.14.
Tel. East 1844

SERVICING

CRUSHING, GRINDING, MIXING and DRYING for the trade.
THE CRACK PULVERISING MILLS, LTD
49/51, Eastcheap, E.C.3
Mansion House, 4406.

"DOHM LTD., PULVERISING" raw materials everywhere, 167, Victoria Street, London, S.W.1.

GRINDING of every description of chemical and other materials for the trade with improved mills. **THOS. HILL-JONES, LTD., "Invicta" Mills, Bow Common Lane London, E. Telegrams: "Hilljones, Bochurch, London," Telephone: 3285 East.**



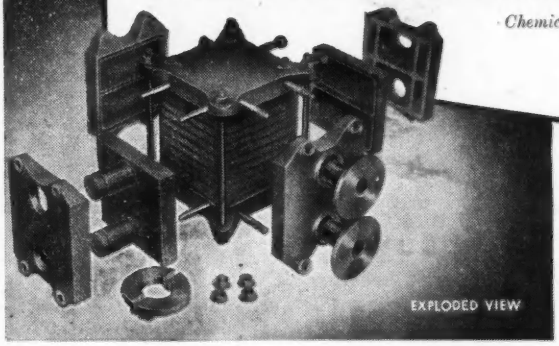
Heat Exchangers

A NEW DEVELOPMENT IN CARBON HEAT EXCHANGERS FOR HIGHLY CORROSIVE CONDITIONS.

The Powell Duffryn Cubic Heat-Exchanger is a highly compact and robust design. It offers (1) complete resistance to the corrosive attack of most acids and alkalis, (2) ease of cleaning and (3) high performance.

These are typical performance figures for Models Nos. 3, 5 & 7.

Effective Heat Transfer area.	*Total heat transmitted under specific conditions.*
50.0 sq. ft.	5,250,000 B.Th.U/hr between steam and a liquid
105.0 sq. ft.	2,200,000 B.Th.U/hr between two corrosive liquids
105.0 sq. ft.	90,000 B.Th.U/hr between corrosive liquid and gas



POWELL DUFFRYN CARBON PRODUCTS LTD.

Chemical Carbons Division,
Springfield Road,
Hayes, Middlesex.

Printed in Great Britain by THE PRESS AT COOMBELANDS Ltd., Addlestone, and published by BENN BROTHERS LTD., at Bouverie House, 154, Fleet Street, E.C.4, 19 May, 1951. Registered at the General Post Office. Entered as Second Class Matter at the New York, U.S.A., Post Office.